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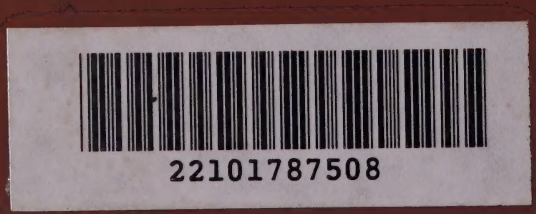
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A

DICTIONARY OF MEDICINE

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A DICTIONARY

OF

MEDICINE

INCLUDING

GENERAL PATHOLOGY, GENERAL THERAPEUTICS,
HYGIENE, AND THE DISEASES PECULIAR
TO WOMEN AND CHILDREN

BY VARIOUS WRITERS

EDITED BY

RICHARD QUAIN, M.D., F.R.S.

FELLOW AND LATE SENIOR CENSOR OF THE ROYAL COLLEGE OF PHYSICIANS
MEMBER OF THE SENATE OF THE UNIVERSITY OF LONDON
MEMBER OF THE GENERAL COUNCIL OF MEDICAL EDUCATION AND REGISTRATION
CONSULTING PHYSICIAN TO THE HOSPITAL FOR CONSUMPTION AND
DISEASES OF THE CHEST AT BROMPTON
ETC.

FOURTEENTH THOUSAND

PART I.

ABDOMEN to LYSIS

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PREFACE.

THE VAST NUMBER of facts and observations, by which the recent progress of scientific and practical medicine has been marked, is diffusely recorded in the Transactions of learned societies, in journals, in monographs, and in systematic treatises. With progress so rapid, and information so diffused, it is extremely difficult alike for the practitioner, the teacher, and the student to keep pace. It was the perception of this difficulty which induced the Editor, when invited to undertake the production of a new Medical Dictionary, to engage in a task which, he was fully conscious, must be one of great labour and of great responsibility. He felt, however, that he would be rendering useful service to his Profession if he could bring together the latest and most complete information in a form which would allow of ready and easy reference. Accordingly, he invited the co-operation of certain of his colleagues and professional friends, both in this country and abroad; and evidence of the readiness with which this invitation has been accepted, is afforded by the list of contributors. Each contributor volunteered or was invited to write on a subject with which he was specially familiar. The present work, which is the result of these combined efforts, may therefore be regarded not only as a dictionary, but also as a treatise on systematic medicine, in which the articles on the more important subjects constitute monographs in themselves, whilst definitions and descriptions of matters having less claim to extended notice are given as fully as is required. Thus an endeavour has been made to supply, in a clear, condensed, and readily accessible form, all the information that is at present available for the use of the practitioner of medicine.

As indicated on the title-page, the work is primarily a dictionary of Medicine, in which the several diseases are fully discussed in alphabetical order. The description of each includes an account of its

ætiology and anatomical characters; its symptoms, course, duration, and terminations; its diagnosis, prognosis, and, lastly, its treatment. General Pathology comprehends articles on the origin, characters, and nature of disease, and the many considerations which these topics suggest. General Therapeutics will be found to include articles on the several classes of remedies—medicinal or otherwise—which are available for the purpose of treatment; on the modes of action of such remedies; and on the methods of their use. The articles devoted to the subject of Hygiene will be found to treat of the causes of disease, of its prevention, of the agencies and laws affecting public health, of the means of preserving the health of the individual, of the construction and management of hospitals, and of the nursing the sick. Lastly, the diseases peculiar to Women and Children are discussed under their respective headings, both in aggregate and in detail.

It may be well to explain that, although it has been found necessary to include some notice of diseases which fall more generally under the care of the surgeon, the work does not pretend to be a dictionary of Surgery; and also that, although certain drugs are enumerated in discussing subjects of general therapeutics, and of poisons and their actions, there has been no intention to invade the domain of Materia Medica.

It is right to observe that all the articles have been edited and revised with great care, so as to ensure a completeness and unity in the work, which it is not always possible to obtain in books composed by a number of writers.

The Editor desires also to state that, although the work has occupied several years in preparation, arrangements were made with the printers which have enabled him to revise every article which required revision, up to the time of going to press. Further, by the addition of an Appendix it has been possible to incorporate the latest contributions to medical knowledge.

Having thus set forth the aims and objects of his undertaking, and how far they have been carried out, the Editor has the great satisfaction of offering his thanks to his friends and colleagues, for the valuable assistance which he has received from them. He is fully conscious of the trouble which must often have been necessary in order

to condense extended knowledge of a familiar subject within the limited space which the nature of this work could afford.

The Editor has further the pleasing duty of offering his special thanks to Dr. Frederick T. Roberts and to Dr. J. Mitchell Bruce, who from the first have been his Assistant-editors and fellow-labourers. Without the help which they have afforded him, it would have been impossible for him to have fulfilled the duties which he undertook. He is well aware of the time and labour which their assistance has involved; and he appreciates most fully the marked ability by which it has been characterised.

The Editor cannot conclude without a reference to some of those who were his friends and colleagues when this work was commenced, but who have since been taken away by death. He would specially mention the names of Edmund Parkes, Charles Murchison, George Callender, Thomas Bevill Peacock, John Rose Cormack, Lockhart Clarke, Tilbury Fox, Thomas Hayden, Harry Leach, Alexander Silver. The loss of these eminent men, many of them dear and valued friends, and all of them taken too soon from their unfinished labours, is to him a source of personal sorrow. The articles written by them for these pages were in most instances their last contributions to medical literature, and will be valued accordingly.

London: *September* 1882.

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LIST OF CONTRIBUTORS.

ADAMS, WILLIAM, Surgeon to the Great Northern Hospital.

AITKEN, WILLIAM, M.D., F.R.S., Professor of Pathology in the Army Medical School Netley.

ALLBUTT, T. CLIFFORD, M.A., M.D., F.R.S., Senior Physician to the Leeds General Infirmary, and Lecturer on Practice of Physic, Leeds School of Medicine.

ALLCHIN, W. H., M.B., F.R.S.E., Physician to, and Lecturer on Physiology and Pathology at, the Westminster Hospital; Physician to the Victoria Hospital for Children.

ANDREW, JAMES, M.D., Physician to, and Joint Lecturer on Physic at, St. Bartholomew's Hospital; Consulting Physician to the City of London Hospital for Diseases of the Chest.

BALFOUR, GEORGE W., M.D., F.R.S.E., Physician to the Royal Infirmary, and Consulting Physician to the Royal Hospital for Children, Edinburgh.

BANHAM, G. A., late Veterinary Assistant at the Brown Institution.

BARNES, ROBERT, M.D., Obstetric Physician to, and Lecturer on Midwifery and Diseases of Women at, St. George's Hospital; Consulting Physician to the Royal Maternity Charity.

BASTIAN, H. CHARLTON, M.A., M.D., F.R.S., Physician to, and Professor of Clinical Medicine at, University College Hospital; Professor of Pathological Anatomy, University College; and Physician to the National Hospital for the Paralysed and Epileptic.

BÄUMLER, C. G. H., M.D., Professor of Clinical Medicine, and Director of the Medical Clinic, University of Freiburg in Baden.

BECK, MARCUS, M.B., M.S., Assistant Surgeon to, and Assistant Professor of Clinical Surgery at, University College Hospital.

BEDDOE, JOHN, B.A., M.D., F.R.S., late Physician to the Bristol Royal Infirmary.

BELLAMY, EDWARD, Surgeon to, and Lecturer on Anatomy at, the Charing Cross Hospital.

BENNET, J. HENRY, M.D., late Physician-Accoucheur, Royal Free Hospital.

BENNETT, SIR J. RISDON, M.D., LL.D., F.R.S., late President of the Royal College of Physicians; Consulting Physician to St. Thomas's Hospital, and to the City of London Hospital for Diseases of the Chest.

BEVERIDGE, ROBERT, M.B., Physician to, and Lecturer on Clinical Medicine at, the Aberdeen Royal Infirmary.

BINZ, CARL, M.D., Professor of Pharmacology in the University of Bonn.

BIRKETT, JOHN, Consulting Surgeon to Guy's Hospital.

BISHOP, JOHN, M.D., C.M., Assistant Surgeon to the Royal Infirmary, Edinburgh.

BLANDFORD, G. F., M.D., Lecturer on Psychological Medicine at St. George's Hospital.

BOWLES, R. L., M.D., Physician to St. Andrew's Convalescent Hospital, Folkestone.

BRISTOWE, J. SYER, M.D., F.R.S., Physician to, and Joint Lecturer on Medicine at, St. Thomas's Hospital.

BROADBENT, W. H., M.D., Physician to, and Lecturer on Medicine at, St. Mary's Hospital; Consulting Physician to the London Fever Hospital.

BROWN-SÉQUARD, C. E., M.D., LL.D., F.R.S., Professor of Medicine, Collège de France.

BRUCE, J. MITCHELL, M.A., M.D., Physician to, and Lecturer on Materia Medica and Therapeutics at, the Charing Cross Hospital; Assistant Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

BRUCE, WILLIAM, M.A., M.D., Physician to the Ross Memorial Hospital, Dingwall.

BRUNTON, T. LAUDER, M.D., D.Sc., F.R.S., Assistant Physician to, and Lecturer on Materia Medica and Therapeutics at, St. Bartholomew's Hospital.

BUCHANAN, GEORGE, B.A., M.D., F.R.S., Medical Officer, H.M. Local Government Board; Consulting Physician to the London Fever Hospital.

BUTLIN, H. T., Assistant Surgeon to, and Demonstrator of Surgery at, St. Bartholomew's Hospital; Surgeon to the Metropolitan Free Hospital.

BUZZARD, THOMAS, M.D., Physician to the National Hospital for the Paralysed and Epileptic.

CADGE, WILLIAM, Surgeon to the Norfolk and Norwich Hospital.

CALLENDER, The late G. W., F.R.S., Surgeon to, and Lecturer on Surgery at, St. Bartholomew's Hospital.

CANTLIE, JAMES, M.A., M.B., C.M., Senior Assistant Surgeon to, and Demonstrator of Anatomy at, the Charing Cross Hospital.

CARPENTER, W. B., C.B., M.D., LL.D., F.R.S.

CARTER, R. BRUDENELL, Ophthalmic Surgeon to, and Lecturer on Ophthalmic Surgery at, St. George's Hospital.

CAYLEY, WILLIAM, M.D., Physician to, and Lecturer on Medicine at, the Middlesex Hospital; Physician to the London Fever Hospital.

CLARKE, The late J. LOCKHART, M.D., F.R.S., Physician to the Hospital for Diseases of the Nervous System.

CLARKE, W. FAIRLIE, M.A., M.D., late Assistant Surgeon to the Charing Cross Hospital.

CLOVER, The late J. T., Lecturer on Anæsthetics at University College Hospital.

COBBOLD, CHARLES S. W., M.D., Senior Assistant Medical Officer, Colney Hatch Asylum.

COBBOLD, T. SPENCER, M.D., F.R.S., Professor of Botany and Helminthology at the Royal Veterinary College.

COLLIE, ALEXANDER, M.D., Medical Officer, Fever Hospital, Homerton.

COOPER, ARTHUR, M.R.C.S., late House Surgeon to the Male Lock Hospital.

CORMACK, The late SIR JOHN ROSE, K.B., M.D., F.R.S.E., Physician to the Hertford British Hospital, Paris.

CUNNINGHAM, D. DOUGLAS, M.D., Surgeon-Major H.M. Bengal Army.

CURLING, T. B., F.R.S., Consulting Surgeon to the London Hospital.

CURNOW, JOHN, M.D., Assistant Physician to King's College Hospital; Professor of Anatomy at King's College; Senior Visiting Physician to the Seamen's Hospital.

DALBY, W. B., B.A., M.B., Aural Surgeon to, and Lecturer on Aural Surgery at, St. George's Hospital.

DAVIDSON, ALEXANDER, M.A., M.D., Physician to the Royal Infirmary, Liverpool, and Lecturer on Pathology at the Liverpool Medical School.

DE ZOUCHE, ISAIAH, M.D., Honorary Physician to the Dunedin Hospital, New Zealand.

DOWN, J. LANGDON, M.D., Physician to, and Lecturer on Clinical Medicine at, the London Hospital.

DUNCAN, J. MATTHEWS, M.A., M.D., LL.D., F.R.S.E., Physician-Accoucheur to, and Lecturer on Midwifery at, St. Bartholomew's Hospital.

DURHAM, ARTHUR E., Surgeon to, and Lecturer on Surgery at, Guy's Hospital.

ECHEVERRIA, M. G., M.D., late Physician-in-Chief to the Hospital for Epileptics and Paralytics, and to the City Asylum for the Insane, New York.

EWART, JOSEPH, M.D., Retired Deputy Surgeon-General, H.M. Bengal Army; late Professor of Medicine, Principal, and Senior Physician, Calcutta Medical College.

EWART, WILLIAM, B.A., M.D., Assistant Physician to St. George's Hospital; late Assistant Physician and Pathologist to the Hospital for Consumption and Diseases of the Chest, Brompton.

FARQUHARSON, ROBERT, M.D., M.P., late Physician to the Belgrave Hospital for Children, and late Assistant Physician to, and Lecturer on Materia Medica at, St. Mary's Hospital.

FAYRER, SIR JOSEPH, K.C.S.I., M.D., LL.D., F.R.S., Honorary Physician to H.M. the Queen, and to H.R.H. the Prince of Wales; President of the Medical Board, India Office; Consulting Physician to the Charing Cross Hospital.

FENWICK, SAMUEL, M.D., Physician to, and late Lecturer on Medicine at, the London Hospital; Assistant Physician to the City of London Hospital for Diseases of the Chest.

FERRIER, DAVID, M.A., M.D., LL.D., F.R.S., Assistant Physician to King's College Hospital; Professor of Forensic Medicine at King's College; Physician to the National Hospital for the Paralysed and Epileptic.

FINNEY, J. M., B.A., M.D., Physician to the City of Dublin Hospital; King's Professor of the Practice of Medicine at the School of Physic in Ireland, and Professor of Clinical Medicine in Sir Patrick Dun's Hospital.

FOSTER, BALTHAZAR W., M.D., Physician to the General Hospital, and Professor of the Principles and Practice of Physic at Queen's College, Birmingham.

FOX, E. LONG, M.D., Consulting Physician to the Bristol Royal Infirmary, and late Lecturer on the Principles and Practice of Medicine at the Bristol School of Medicine.

FOX, T. COLCOTT, B.A., M.B., Physician to the St. George's and St. James's Dispensary; Asistant Physician to the Victoria Hospital for Children.

FOX, The late TILBURY, M.D., Physician to the Skin Department, University College Hospital.

GALTON, CAPTAIN DOUGLAS, R.E. (retired), C.B., D.C.L., F.R.S.

GASCOYEN, The late GEORGE G., Surgeon to the Lock Hospital; and Assistant Surgeon to, and Lecturer on Surgery at, St. Mary's Hospital.

GEE, SAMUEL, M.D., Physician to St. Bartholomew's Hospital, and to the Hospital for Sick Children; Joint-Lecturer on Practice of Physic at St. Bartholomew's Hospital.

GODLEE, RICKMAN J., B.A., M.B., M.S., Assistant Surgeon to University College Hospital; Demonstrator of Anatomy at University College; Assistant Surgeon to the North-East Hospital for Children.

GODSON, CLEMENT, M.D., Consulting Physician to the City of London Lying-in Hospital; Assistant Physician-Accoucheur to St. Bartholomew's Hospital.

GOWERS, W. R., M.D., Assistant Physician to, and Assistant Professor of Clinical Medicine at, University College Hospital; Physician to the National Hospital for the Paralysed and Epileptic.

GREEN, T. HENRY, M.D., Physician to, and Lecturer on Pathology at, the Charing Cross Hospital; Assistant Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

GREENFIELD, W. S., M.D., Professor of General Pathology and Clinical Medicine in the University of Edinburgh.

GRIMSHAW, T. W., M.A., M.D., Registrar-General for Ireland; Consulting Physician to the Fever Hospital, and to Steeven's Hospital, Dublin.

HAWARD, J. WARRINGTON, Surgeon to St. George's Hospital; late Assistant Surgeon to the Hospital for Sick Children.

HAYDEN, The late THOMAS, Physician to the Mater Misericordiæ Hospital, Dublin; Professor of Anatomy and Physiology, Catholic University, Dublin.

HERMAN, G. ERNEST, M.B., Assistant Obstetric Physician to the London Hospital; Physician to the Royal Maternity Charity.

HICKS, J. BRAXTON, M.D., F.R.S., Physician-Accoucheur to, and Lecturer on Midwifery and Diseases of Women and Children at, Guy's Hospital.

HILL, BERKELEY, M.B., Surgeon to, and Professor of Clinical Surgery at, University College Hospital; Teacher of Practical Surgery at University College; Surgeon to the Lock Hospital.

HOLMES, TIMOTHY, M.A., Surgeon to, and Lecturer on Surgery at, St. George's Hospital.

HORSLEY, V. A. H., B.S., M.B., Assistant to the Professor of Pathological Anatomy, University College; Surgical Registrar, University College Hospital.

HOWARD, BENJAMIN, M.D., late Professor of Medicine, and Lecturer on Medicine, in the University of New York.

HUTCHINSON, JONATHAN, F.R.S., Senior Surgeon to the London Hospital, and to the Hospital for Diseases of the Skin; Consulting Surgeon to the Royal London Ophthalmic Hospital.

IRVINE, The late J. PEARSON, B.A., B.Sc., M.D., Assistant Physician to, and Lecturer on Forensic Medicine at, the Charing Cross Hospital; Physician to the Victoria Hospital for Children.

JENNER, SIR WILLIAM, Bart., K.C.B., M.D., D.C.L., LL.D., F.R.S., Physician-in-Ordinary to H.M. the Queen, and to H.R.H. the Prince of Wales; President of the Royal College of Physicians; Consulting Physician to University College Hospital.

JONES, JOSEPH, M.D., President Board of Health, State of Louisiana, New Orleans.

LATHAM, P. W., A.M., M.D., Physician to Addenbrooke's Hospital; Downing Professor of Medicine in the University of Cambridge.

LEACH, The late HARRY, Medical Officer of Health for the Port of London, and Physician to the Seamen's Hospital, Greenwich.

LEGG, J., WICKHAM, M.D., Assistant Physician to, and Lecturer on Pathological Anatomy at, St. Bartholomew's Hospital.

LEWIS, TIMOTHY, M.D., Surgeon-Major, H.M. Army.

LITTLE, JAMES, M.D., Physician to the Adelaide Hospital, Dublin; Professor of Practice of Physic in the Royal College of Surgeons in Ireland; Consulting Physician to the Rotunda Lying-in Hospital.

LIVEING, ROBERT, M.A., M.D., Physician for Diseases of the Skin to, and Lecturer on Diseases of the Skin at, the Middlesex Hospital.

McCARTHY, JEREMIAH, M.A., M.B., Surgeon to, and Lecturer on Physiology at, the London Hospital.

MAC CORMAC, SIR WILLIAM, M.A., M.Ch., Surgeon to, and Lecturer on Surgery at, St. Thomas's Hospital.

McKENDRICK, J. GRAY, M.D., F.R.S.E., Professor of the Institutes of Medicine in the University of Glasgow.

MACKENZIE, STEPHEN, M.D., Physician to, and Lecturer on the Principles and Practice of Medicine at, the London Hospital.

MACLEAN, W. C., C.B., M.D., Inspector-General of Hospitals; Professor of Military Medicine in the Army Medical School, Netley.

MACNAMARA, CHARLES, Surgeon to the Westminster Hospital, and to the Westminster Ophthalmic Hospital; Joint-Lecturer on Surgery at the Westminster Hospital.

MACPHERSON, JOHN, M.A., M.D., Inspector-General of Hospitals, H.M. Bengal Army (retired); Physician to the Scottish Hospital.

MADDEN, T. MORE, Obstetric Physician to the Mater Misericordiæ Hospital, Dublin.

MANSON, PATRICK, M.D., Amoy.

MEREDITH, W. A., M.B., C.M., Surgeon to the Samaritan Free Hospital for Women and Children.

MERYON, The late EDWARD, M.D., Physician to the Hospital for Epilepsy and Paralysis.

MUIRHEAD, CLAUD, M.D., Physician to, and Lecturer on Clinical Medicine at, the Royal Infirmary, Edinburgh.

MURCHISON, The late CHARLES, M.D., LL.D., F.R.S., Physician to, and Special Professor of Clinical Medicine at, St. Thomas's Hospital; Consulting Physician to the London Fever Hospital.

MYERS, A. B. R., Surgeon, Coldstream Guards.

NETTLESHIP, EDWARD, Ophthalmic Surgeon to St. Thomas's Hospital, and to the Hospital for Sick Children; Lecturer on Ophthalmic Surgery at St. Thomas's Hospital

NIGHTINGALE, FLORENCE.

OLIVER, GEORGE, M.D., Harrogate.

ORD, W. M., M.D., Physician to, and Lecturer on Medicine at, St. Thomas's Hospital.

PAGET, SIR JAMES, Bart., D.C.L., LL.D., F.R.S., Sergeant-Surgeon to H.M. the Queen; Surgeon to H.R.H. the Prince of Wales; Consulting Surgeon to St. Bartholomew's Hospital.

PARKES, The late EDMUND A., M.D., F.R.S., Professor of Hygiene in the Army Medical School, Netley.

PAVY, F. W., M.D., F.R.S., Physician to, and Lecturer on Medicine at, Guy's Hospital.

PAYNE, J. FRANK, B.A., B.Sc., M.D., Senior Assistant Physician to, and Lecturer on General Pathology at, St. Thomas's Hospital.

PEACOCK, The late T. BEVILL, M.D., Honorary Consulting Physician to St. Thomas's Hospital; and Consulting Physician to the City of London Hospital for Diseases of the Chest.

PLAYFAIR, W. S., M.D., Physician-Accoucheur to H.I. and R.H. the Duchess of Edinburgh; Physician for Diseases of Women and Children to King's College Hospital, and Consulting Physician to the General Lying-in Hospital; Professor of Obstetric Medicine at King's College.

POORE, G. VIVIAN, M.D., Assistant Physician to University College Hospital; Professor of Medical Jurisprudence, University College.

POWELL, R. DOUGLAS, M.D., Physician to the Middlesex Hospital, and to the Hospital for Consumption and Diseases of the Chest, Brompton.

QUAIN, RICHARD, M.D., F.R.S., Consulting Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

RADCLIFFE, J. NETTEN, Assistant Medical Officer, Local Government Board.

REDWOOD, THEOPHILUS, Ph.D., Professor of Chemistry and Pharmacy, Pharmaceutical Society of Great Britain.

ROBERTS, FREDERICK T., M.D., B.Sc., Physician to, and Professor of Clinical Medicine at, University College Hospital; Professor of Materia Medica at University College; Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

ROBERTS, WILLIAM, B.A., M.D., F.R.S., Physician to the Manchester Royal Infirmary; Professor of Clinical Medicine, Owens College School of Medicine.

ROSE, WILLIAM, B.S., M.B., Assistant Surgeon to King's College Hospital; Surgeon to the Royal Free Hospital.

ROY, C. S., M.D., Professor Superintendent of the Brown Institution, London.

RUSSELL, JAMES A., M.A., M.B., C.M., Inspector of Anatomy for Scotland; Lecturer on Sanitation, Watt's Institution, Edinburgh.

SALTER, S. J., M.B., F.R.S., F.L.S., Late Dental Surgeon to Guy's Hospital.

SANGSTER, ALFRED, B.A., M.B., Physician for Diseases of the Skin to, and Lecturer on Skin Diseases at the Charing Cross Hospital.

SAUNDBY, R. M.D., Assistant Physician to the General Hospital, Birmingham.

SEATON, The late EDWARD C., M.D., Medical Officer, Local Government Board.

SHAPTER, THOMAS, M.D., LL.D., Consulting Physician to the Devon and Exeter Hospital.

SIBBALD, JOHN, M.D., F.R.S.E., Commissioner in Lunacy for Scotland.

SILVER, The late ALEXANDER, M.A., M.D., Physician to, and Lecturer on Physiology at, the Charing Cross Hospital.

SIMON, JOHN, C.B., D.C.L., LL.D., F.R.S., Consulting Surgeon to St. Thomas's Hospital; late Medical Officer to Her Majesty's Privy Council, and to the Local Government Board.

SIMPSON, ALEXANDER R., M.D., Physician to the University Clinical Ward for Diseases of Women, Royal Infirmary, Edinburgh; Professor of Midwifery and Diseases of Women and Children in the University of Edinburgh.

SMITH, EUSTACE, M.D., Physician to H.M. the King of the Belgians; Physician to the City of London Hospital for Diseases of the Chest, and to the East London Hospital for Children.

SMITH, W. JOHNSON, Surgeon to the Seamen's Hospital, Greenwich.

SOUTHEY, REGINALD, M.D., Physician to, and Lecturer on Forensic Medicine and Hygiene at, St. Bartholomew's Hospital.

SPARKS, The late EDWARD I., M.A., M.B., Physician for Diseases of the Skin to the Charing Cross Hospital, and Physician to the Royal Infirmary for Women and Children.

SQUIRE, WILLIAM, M.D., Physician to the North London Hospital for Diseases of the Chest, and to St. George's Dispensary.

STEVENSON, THOMAS, M.D., Lecturer on Chemistry and Medical Jurisprudence at Guy's Hospital; Analyst to St. Pancras, &c.

STEWART, T. GRAINGER, M.D., F.R.S.E., Ordinary Physician to H.M. the Queen in Scotland; Professor of Practice of Physic in the University of Edinburgh.

STREATFEILD, J. F., Surgeon to the Royal London Ophthalmic Hospital; Professor of Clinical Ophthalmic Surgery at, and Ophthalmic Surgeon to, University College Hospital.

THIN, GEORGE, M.D., London.

THOMPSON, E. SYMES, M.D., Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

THOMPSON, SIR HENRY, Surgeon Extraordinary to H.M. the King of the Belgians; Consulting Surgeon to University College Hospital; Emeritus Professor of Clinical Surgery at University College.

THORNTON, W. PUGIN, Surgeon to the St. Marylebone General Dispensary.

THOROWGOOD, J. C., M.D., Physician to the City of London Hospital for Diseases of the Chest, and to the West London Hospital; Lecturer on Materia Medica at the Middlesex Hospital.

TUKE, J. BATTY, M.D., F.R.S.E., formerly Lecturer on Mental Diseases at the Royal College of Surgeons, Edinburgh.

WALKER, T. J., M.D., Surgeon to the Peterborough Infirmary and Dispensary.

WARD, The late STEPHEN H., M.D., Consulting Physician to the Seamen's Hospital, Greenwich; and Physician to the City of London Hospital for Diseases of the Chest.

WARDELL, J. R., M.D., Consulting Physician to the Tunbridge Wells Infirmary.

WATERS, A. T. H., M.D., Physician to the Royal Infirmary, Liverpool; Lecturer on Principles and Practice of Medicine at the Liverpool School of Medicine.

WEBER, HERMANN, M.D., Physician to the German Hospital.

WELLS, T. SPENCER, President of the Royal College of Surgeons; Surgeon to the Queen's Household; Consulting Surgeon to the Samaritan Hospital for Women and Children.

WILLIAMS, C. THEODORE, M.A., M.D., Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

WILSON, SIR ERASMUS, LL.D., F.R.S., late President of the Royal College of Surgeons; Professor of Dermatology, Royal College of Surgeons.

WILTSHIRE, ALFRED, M.D., Physician-Accoucheur to, and Joint Lecturer on Obstetric Medicine at, St. Mary's Hospital; Physician for Diseases of Women to the West London Hospital.

WOOD, JOHN, F.R.S., Surgeon to King's College Hospital, and Professor of Clinical Surgery at King's College.

DICTIONARY OF MEDICINE.

A

ABDOMEN, Diseases of the. — Before entering upon the study of the particular diseases which are liable to be met with in connexion with each of the principal regions of the body, it is expedient to regard them from a general point of view, as such a course helps materially in clearing the way for their clinical investigation. This general survey is particularly advantageous in the case of abdominal diseases, which are necessarily very numerous and varied, both as regards the structure affected and the nature of the morbid change they present; they are consequently difficult to recognise with certainty in many instances, and are occasionally involved in much obscurity.

Excluding a few peculiar affections, the diseases of the abdomen may be arranged under the following groups :—

I. Diseases of the anterior abdominal walls.

II. Diseases of the peritoneum and its folds.

III. Diseases of the organs contained within the abdominal cavity, namely :— 1, Stomach and Intestines; 2, Hepatic organs, including the liver, gall-bladder, and gall-ducts; 3, Spleen; 4, Pancreas; 5, Supra-renal capsules; 6, Urinary apparatus, viz., the kidneys and their ducts, and the bladder; 7, Female generative organs, including the uterus and its broad ligament, the Fallopian tubes, and the ovaries; 8, Absorbent glands.

IV. Diseases of the abdominal vessels, especially the aorta and the iliac arteries.

V. Diseases of the sympathetic or other nerves contained within the abdomen.

VI. Diseases originating in connexion with the cellular tissue, such as inflammation or abscess.

VII. Diseases springing from the posterior boundary of the abdomen; from the pelvis or the structures lining it; or from the diaphragm, and invading the abdominal cavity.

VIII. Diseases encroaching upon the abdomen from other parts, especially from the thorax.

It must be borne in mind that the groups of diseases above-mentioned may be presented in various combinations, two or more structures being not uncommonly implicated at the same time.

The special nature and mode of origin of the diseases thus summarised will be discussed under their appropriate headings, but a few general observations on this subject may prove serviceable. Several of the abdominal organs are very liable to so-called *functional disorders*, being much exposed to the repeated action of various disturbing influences, and these disorders often give rise to prominent and troublesome symptoms, which are urgently complained of by the patient. Definite *organic diseases* are also of common occurrence, many of them being of a very serious character. Some of the organs contained within the abdomen are subject to *malposition* or *displacement*, as well as to *malformations*, these being either congenital or acquired; while the hollow viscera may be the seat of *obstruction* or *accumulations* of different kinds; and each of these conditions may become clinically important.

Abdominal lesions are frequently purely *local* in their origin, but several of them are but local manifestations of some general condition, being either associated with certain acute febrile diseases, *e.g.*, typhoid fever; or with some constitutional cachexia, such as cancer. Again, symptoms connected with the abdomen may depend upon disease in some remote part of the body, or some of its organs may become the seat of morbid changes as a consequence of disease in other structures. For instance, vomiting is frequently associated with cerebral disorders; while affections of the heart are liable to lead to troublesome symptoms, as well as to serious lesions in connexion with many of the abdominal viscera. Lastly, a morbid condition of one organ within the abdomen may be the direct means of originating *secondary* mischief in other structures.

Clinical Investigation.— The clinical examination of cases in which the symptoms point to the abdomen as the seat of mischief should always be conducted with particular care and thoroughness, as well as in a systematic manner, otherwise serious mistakes are liable to be made. It is also very desirable to avoid forming any definite conclusion as to the nature of the complaint hastily or on insufficient data, but rather to wait and observe the course of events in any doubtful case, repeating the investigation from time to

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time, when any obscurity which may exist will often be cleared away. The past and family history of the patient, with the course and progress of the symptoms, are often of material assistance in diagnosis, and demand due attention in every instance. The chief clinical phenomena which may be associated with abdominal affections, and with reference to which it is requisite to inquire, may be thus indicated. First, there are usually symptoms directly connected with the structure implicated, such as pain and other morbid sensations, disorders of secretory or other functions, or excited action. Secondly, several of the organs mutually affect each other, either from being anatomically or physiologically related, or from a morbid condition of one part causing pressure upon or irritation of some neighbouring structure. In this way numerous symptoms are liable to arise, sometimes in remote parts, and often of material significance. Thirdly, sympathetic or reflex phenomena in connexion with organs in other regions of the body are frequently excited by many abdominal disorders, such as palpitation of the heart, convulsions, and other nervous disturbances. Fourthly, the general system often suffers seriously, and in various ways. For instance, pyrexia may be excited; the blood may become impoverished or impregnated with noxious materials; or more or less general wasting and debility may be induced. Where an abdominal disease is but a local manifestation of some constitutional condition, it commonly aggravates materially the general symptoms; while in connexion with lesions of certain of the abdominal viscera these general symptoms constitute in many cases the most prominent clinical features. Fifthly, morbid conditions within the abdomen not unfrequently interfere directly with the diaphragm and the thoracic organs; occasionally also they invade upon the chest, or actually make their way into this cavity through the diaphragm. In rare instances morbid products, such as pus, may find their way to distant parts of the body. In these different ways a variety of symptoms may be caused, sometimes of a curious nature and difficult to explain. Lastly, abdominal diseases are frequently attended with abnormal physical or objective signs, which are revealed on physical examination, and these are of such importance that they demand separate consideration.

Physical Examination. — The neglect of submitting patients to a satisfactory physical examination is a frequent source of error in diagnosis in cases of abdominal disease, and there ought to be no hesitation or delay in resorting to this method of clinical investigation whenever it seems called for. The precise course to be pursued must vary according to circumstances, but the following outline will serve to indicate the plan of procedure ordinarily required.

First, there are certain modes of examination which are applied to the abdomen externally, including *Inspection*; *Palpation* or *Manipulation*; *Mensuration* or *Measurement*; *Percussion*; and *Auscultation* (*see* Physical Examination). Of these, inspection, palpation, and percussion are by far the most important, and have, in the large majority of cases, to be relied upon for the information required. In exceptional instances *Succussion* or shaking the patient proves serviceable, by bringing out certain sensations or sounds. In order to carry out these methods properly, it is necessary to expose the abdomen sufficiently, due regard being paid to decency in the examination of females; to place the patient in a suitable position; and to see that the muscles of the abdominal walls are duly relaxed. The best position usually is for the patient to lie on the back, in a half-reclining attitude, with the head and shoulders well raised, and the thighs and knees more or less flexed. This posture serves to relax the abdominal muscles, which may be further aided by taking off the patient's attention by conversation or in other ways, as well as by directing him to breathe deeply. The position, however, has often to be varied in the investigation of particular cases, and much information is frequently gained by noticing the effects of altering the posture.

The objective conditions which may be revealed by the modes of examination thus far considered are as follows:—1. The state of the superficial structures. 2. The size and shape of the abdomen, generally and locally, as indicating an alteration in the volume of the ordinary contents of the abdomen, or the presence of some new or fresh element, such as dropsical fluid or a tumour. 3. The characters of the abdominal respiratory movements; and the presence of any unusual sensations during the act of breathing, such as friction-fremitus. 4. The sensations experienced on palpation and percussion over the abdomen, either as a whole, or in any particular part of it, such as its mobility, degree of resistance, regularity, consistence, &c.; as well as the presence of certain peculiar sensations, *e.g.*, fluctuation, or hydatid-fremitus. 5. The presence and characters of any pulsation. 6. The occurrence of abnormal movements within the abdomen, as those of a fœtus. 7. The sounds elicited, generally and locally, on percussion. 8. The presence of certain sounds within the abdomen, heard on auscultation, such as friction-sounds, murmurs connected with aneurism or due to pressure on an artery; or murmurs and sounds associated with the pregnant uterus.

Secondly, it not uncommonly happens that special modes of examination have to be applied to particular organs within the abdomen, in order to arrive at a diagnosis with any certainty. And here it may be remarked that it is highly important in all cases to see that no accumulation of fæces exists within the bowels, and that the bladder is properly emptied, otherwise very serious mistakes are liable to be made. Purgatives and enemata are needed in order to remove any fæcal collection. The urine should also be properly tested in every instance; and much information may often be gained in the investigation of affections of the alimentary canal, from a personal inspection or more complete examination of fæces or vomited matters. The abdominal organs to which special modes of examination are chiefly applicable are the female generative organs, which are investigated per vaginam (*see* Womb, Diseases of); the bladder, by means of the catheter, the sound, and other

surgical instruments; the stomach, by the use of the stomach-pump, probang, &c.; and the intestines, by examining with the finger, hand, or surgical instruments per rectum, or by injecting water or air through the anus into the bowels. The ordinary modes of examination already mentioned may afford assistance when employed along with some of the special methods just indicated.

Thirdly, occasionally it is requisite to have recourse to exceptional modes of investigation, such as the use of the exploring trochar or aspirator; or to the administration of chloroform. The latter may afford direct information in certain abdominal conditions, and it may also materially assist in carrying out other methods of exploration.

The abnormal conditions discoverable by physical examination may involve the entire abdomen, giving rise, for instance, to general enlargement or retraction; or they may be limited to some particular region, *e.g.*, enlarged organs, tumours, or abscesses. This part of the body has been artificially divided by anatomists into regions, and the seat of any local morbid condition can thus be defined and described. The diseases peculiar to the several regions will be considered under their respective headings.

FREDERICK T. ROBERTS.

ABDOMINAL ANEURISM includes aneurism of the aorta, and of any of its branches within the abdomen.

Aneurism of the Abdominal Aorta is essentially a disease of middle age. Of fifty-nine cases collected by Dr. Crisp, thirty-three were under the age of forty. It is more common in the male than in the female sex in the proportion of about 8 : 1; and is usually traceable to strain, or to a blow upon the abdomen or back. The aneurism is most frequently located in that portion of the vessel included between the aortic opening in the diaphragm and the origin of the superior mesenteric artery. In this situation the tumour is deeply seated; liable to tension from the crura of the diaphragm; and likely to involve the great splanchnic nerves, the semilunar ganglia, and the solar plexus. Hence the occasional difficulty of diagnosis; and the frequency of boring pain in the back from erosion of the vertebræ, and of paroxysms of radiating pain in the abdominal viscera from stretching of the adjacent nerves. When situated lower down in the course of the aorta, the disease is less obscure, and the symptoms are less urgent. Aneurism of the abdominal aorta is usually of the *false* variety; and, as contrasted with thoracic aneurism, it is less often associated with extensive atheroma of the aorta, and with fatty or other structural disease of the heart. The symptoms referable to excentric pressure are also fewer, and, with the exception of pain, are less urgent.

SYMPTOMS AND SIGNS.—Of the symptoms, *pain* is the most characteristic and the most urgent; it is of two kinds, which are not, however, necessarily associated. In its usual form the pain of abdominal aneurism is essentially neuralgic; it is intermittent and paroxysmal,—radiating through the abdomen, back, pelvis, and base of the thorax, and not unfrequently into either groin or testicle. The accession is sudden, and usually attributable to some definite cause of vascular excitement. The duration extends over a period varying from one to three hours, rarely longer; and the cessation is equally abrupt, leaving the patient in a state of exhaustion, but quite free from actual suffering. The second kind of pain referred to is continuous and boring; fixed at a particular point of the vertebral column; aggravated by pressure at this point, by active movement or stamping, and by gently turning the patient half round upon his axis in the standing posture; but relieved by anti-recumbency or leaning forward. Pain so characterised is pathognomonic of erosion of the vertebræ. Pressure of an aneurism may affect the functions of several organs within the abdomen. Thus *jaundice* may result from pressure upon the hepatic or common biliary duct: it is, however, more frequently due to an aneurism of the hepatic or of the superior mesenteric artery. *Interference with the urinary secretion*, and the consequences thereof, from pressure upon the renal vessels; *dysphagia* from pressure upon the œsophagus; *vomiting* from obstruction of the pylorus; *displacement* of the liver forwards, or of the heart upwards—though rare symptoms—may be likewise due to the same cause. The radial pulse is not often affected. Symptoms of *constitutional* irritation and impaired nutrition are rarely exhibited, and appear only at the termination of protracted and painful cases, associated with great suffering and want of sleep.

The *physical signs* are those discoverable by palpation, percussion, and auscultation. The tumour usually projects to the left of the mesial line, and tends to descend; it is smooth and elastic; communicating to the hand alternate movements of lifting and expansion with increasing tension, and of subsidence with relaxation. The pulsation is all but invariably single, and synchronous with the radial pulse; it is limited to the tumour, and occasionally accompanied by thrill. Pressure upon the aorta below the tumour will increase the force of impulse, diminish or abolish the thrill, and arrest the collapse. In a few recorded examples the tumour was hard and uneven on the surface, and non-expansile; and in a still smaller number no pulsation was perceptible, the aperture of communication with the artery having been blocked, or the vessel compressed on the proximal side by the growth of the aneurism itself. Owing to the position of the hollow viscera in front, and the mass of lumbar muscles behind, the evidence from percussion is less conclusive in regard to abdominal than thoracic aneurism. If, however, the abdominal muscles be relaxed, and the stomach and bowels free from flatus, absolute dulness to the extent of the tumour may be detected. A sound, single or double, as distinguished from murmur, is rarely heard in front in connexion with abdominal aneurism; whereas the existence of sound without murmur, and usually double, at a point of the posterior wall of the abdomen corresponding to the tumour, is the rule, and, when detected, is of the utmost diagnostic value. Murmur in the recumbent posture is rarely absent in front; it is single, blowing, prolonged, post-systolic, and not transmitted into the vessel beyond. It may, however, be musical, or it may present both these characters, but at dif-

ferent points of the tumour; in one instance it was of a buzzing quality. Should the aneurism have taken an exclusively backward course, which is the exception, a single murmur, not audible in front, may be heard in the back. In a few recorded cases a double murmur has been heard over the aneurism in front. In the erect posture the murmur is usually suspended; but in a few published cases it was audible in both the erect and the recumbent posture, and in one at least in the erect posture only. These peculiarities depend upon the various conditions of the sac, its orifice, and its contents. A small aneurism engaging the posterior wall of the vessel only, and eroding the vertebræ, may be latent as to physical signs, though attended with severe fixed pain in the back.

Diagnosis.—The diagnosis of abdominal aneurism has reference mainly to its physical signs. Strong pulsation of the aorta, simulating that of aneurism, may exist in connexion with hysteria, uterine or intestinal irritation, dyspepsia, or copious hæmorrhage. But in all these cases, irrespectively of the positive and specific evidence presented by each, throbbing exists throughout the aorta, and is propagated into the main arteries of the lower limbs, whereas it is localised in aneurism; and a careful exploration of the aorta, if necessary under the influence of chloroform, will show that its dimensions are at all points normal. In these cases, too, although a murmur may be produced by strong pressure with the stethoscope, it does not exist when pressure is withdrawn. A cancerous or other tumour pressing upon the aorta may likewise produce murmur, and may exhibit pulsation communicated from the aorta; but in most cases both these phenomena are promptly arrested by placing the body in the prone position; the tumour, in that position, gravitating *from* the vessel. The fixed local pain in the back, aggravated by pressure and motion, may be simulated by spinal rheumatism; and the paroxysmal visceral pain by biliary colic. The differential diagnosis must rest upon the specific evidence in each case, and upon the absence of the signs of aneurism.

Aneurism of the Branches of the Abdominal Aorta.—The branches most liable to aneurism are the common iliacs and their divisions; the cœliac axis and its branches; the renal and the superior mesenteric. *Aneurism of the Iliac Arteries* belongs to the domain of surgery, and will not be further referred to here. *Aneurism of the Cœliac Axis* and of its branches of division, and of the *Superior Mesenteric Artery*, are, in addition to the ordinary signs, equally characterized by mobility; and the first two varieties by jaundice, hæmatemesis, and melæna, from pressure. Renal aneurism may cause obstruction in the kidney or renal colic by pressure on the structures in the hilus.

Duration and Terminations.—The duration of life in cases of abdominal aneurism has, in the writer's experience, varied from fifteen days to eleven years. Death occurs usually (1) by rupture of the sac into (*a*) the retro-peritoneal tissue; (*b*) the cavity of the peritoneum; (*c*) the left pleura or lung; (*d*) the intestinal canal; (*e*) the inferior cava; (*f*) the psoas muscle; (*g*) the pelvis of the kidney; (*h*) the spinal canal, or (*i*) the ureter, biliary passages, or œsophagus; and in the order of relative frequency just given; or (2) by exhaustion or syncope. The duration of life after the rupture of the aneurism has ranged from a few minutes to several weeks. A consecutive false aneurism of the retro-peritoneum is specially characterised by feeble pulsation of the tumour, and diminished or arrested circulation in the femoral artery of one of both sides.

Treatment.—The *Curative* treatment of abdominal aneurism may be considered under three heads—*Mechanical*, *Postural* and *Dietetic*, and *Medicinal*. Mechanical treatment consists in pressure applied to the aorta on the proximal side of the sac, or simultaneously on its proximal and distal sides, by means of tourniquets, so as completely to stop the circulation. The bowels should be first well moved and freed from flatus; and during the continuance of pressure the patient should be kept under the influence of chloroform or ether. Five cases, if not more, in which a cure was effected by these means have been reported. The object sought to be attained being that of effecting rapid coagulation in the sac, the period during which pressure needs to be continued in these cases varies from three quarters of an hour to ten hours and a half. Where space for the application of proximal pressure does not exist, distal pressure alone may be tried. Under all circumstances, pressure must be used with circumspection, as inflammation of the peritoneum or of the bowels may result from it.

Bellingham introduced the plan of treatment by posture and restricted diet. Under this plan perfect repose of mind and body is, as far as practicable, to be maintained; the bowels being kept moderately free, and the dietary restricted to 10 oz. of solids and 6 oz. of liquids daily. According to the method of Mr. Tufnell, which is based upon the same principle, but is more rigid, the patient is strictly confined to the horizontal posture for a period varying from eight to thirteen weeks, as determined by the effect upon the aneurism, movement in bed being effected with caution; whilst, by a special arrangement, the bowels and the bladder may be evacuated without disturbance of the body. For breakfast, 2 oz. of white bread and butter, with 2 oz. of cocoa or milk, are allowed; for dinner, 3 oz. of meat, with 3 oz. of potatoes or bread, and 4 oz. of water or claret; and for supper, 2 oz. of bread and butter, and 2 oz. of milk or tea. The total amount in the twenty-four hours would be, solids 10 oz., liquids 8 oz. This system might be in some degree relaxed if the patient prove restive. Mild laxatives and opiates as required are the only medicines used. Ten cases of the successful treatment of aortic aneurism by this method have been reported by Mr. Tufnell. Abdominal aneurism was solidified in two instances, after treatment extending over thirty-seven and twenty-one days respectively.

Of the various medicinal agents used with a view to favouring or effecting a deposit of laminated fibrin in the sac, acetate of lead, iodide of potassium, aconite, and ergotin (hypodermically), alone claim attention. Iodide of potassium may be given with advantage in doses

of 10 to 20 grs. thrice daily, with a view to reducing vascular tension, and thereby relieving pain and promoting deposition in the sac, whilst perfect rest in the recumbent posture and a restricted dietary are observed. The latter are, however, the more important factors in the treatment. Dr. G. W. Balfour has reported several cases successfully treated by means of iodide of potassium; and recently an example of a similar kind has been published by Dr. Dyce Duckworth. Dr. Grimshaw has lately had an example of cure mainly through the use of aconite. At the same time the allowance of liquids must be reduced to the lowest possible standard, whilst excretion is promoted. Alcoholic stimulants may be given in small quantity and at long intervals, if the pulse exhibit debility and the patient complain of a sensation of sinking; otherwise they should be prohibited.

The *Palliative* treatment as applied to Abdominal Aneurism will be found described in the article Aorta, Diseases of (*Aneurism*). The application of a few leeches, followed by a warm poultice, is very efficacious in relieving pain. The hypodermic use of morphia is still more rapidly effective. Thomas Hayden.

ABDOMINAL TYPHUS. — A synonym for Typhoid Fever. *See* Typhoid Fever.

ABDOMINAL WALLS, Diseases of. But little more will be needed in this article than to give a brief outline of the nature of the affections to which the abdominal walls are liable, as most of these are but local forms of diseases which are fully described in other parts of this work. The parietal peritoneum will be excluded from consideration, as its morbid conditions are treated of separately.

1. Superficial Affections. — *a.* The skin covering the abdomen may be the seat of various eruptions. The rash of typhoid fever is chiefly observed over this region. *b.* When the abdomen is greatly enlarged, its cutaneous covering becomes stretched and thinned, often presenting a shining appearance; this may even give way, so that it exhibits superficial cracks or fissures. If it has been distended for a considerable time or on several occasions, as after repeated pregnancies, the skin becomes impaired in its structure, and is often the seat of permanent white lines or furrows—*lineæ albicantes*. In this connection allusion may be made to the umbilicus, which, in certain forms of distension of the abdomen, may become pouched out, everted, or actually obliterated. *c.* The veins of the skin frequently become enlarged and tortuous, when the return of the blood which is normally conveyed through them is in any way impeded. The particular vessels which are distended will necessarily depend upon the seat of the obstruction. *d.* The cutaneous sensibility over the abdomen is sometimes materially altered. In certain nervous diseases it may become more or less impaired or lost; but the most important deviation is a marked increase of sensibility—*hyperæthesia*—which is occasionally observed in hysterical females, and which may simulate more serious affections, particularly peritonitis, especially if it is accompanied with symptoms of much depression. This condition is characterised by extreme *superficial* sensibility or tenderness of the abdomen, the slightest touch being resented; but if the patient's attention can be taken off, and deep pressure be then made, this is borne with little or no indication of distress. The aspect of the patient, the presence of other symptoms indicative of hysteria, and the absence of pyrexia, usually serve to distinguish this affection from others of a graver nature. The surface of the abdomen may also be affected with neuralgia, which is sometimes very severe.

2. Subcutaneous Accumulations. — *a.* The chief morbid condition coming under this head is *œdema* or *dropsy* of the subcutaneous tissue. This generally follows anasarca of the legs, and may be associated with ascites. The fluid tends to collect especially in the lower part of the abdominal walls and towards the flanks. The skin often presents a white pasty aspect; the abdomen may be more or less enlarged; the umbilicus appears depressed and sunken, if the œdema extends up to this level; the superficial structures pit on pressure, and yield the peculiar sensation of dropsical tissues; and the percussion note is frequently muffled. *b.* The abdominal subcutaneous tissue is, in many persons, the seat of an abundant collection of fat, which may be important from its causing general enlargement, and simulating or obscuring other more serious morbid conditions which enlarge the abdomen.

3. Affections of the Muscles and Aponeuroses.—*a.* The abdominal walls may be the seat of muscular rheumatism, which is particularly likely to follow undue straining, such as that caused by violent coughing or vomiting. It is characterised by pain, sometimes severe, evidently located in the muscular and tendinous structures, accompanied with much soreness and tenderness. The affected parts are kept as much at rest as possible, and any action which disturbs them materially aggravates the pain. *b.* As the result of violent strain, the muscular or aponeurotic tissues may be more or less torn or ruptured. As a consequence a protrusion of some internal structure may take place, forming a hernia. *c.* The abdominal muscles are liable to be the seat of spasmodic contractions, cramp, or rigidity. These are not uncommonly excited in sympathy with grave disturbance of the alimentary canal, as in cholera. In certain painful internal affections also some of the abdominal muscles are occasionally kept in a state of more or less rigid tension, as if they were involuntarily contracted in order to protect the diseased parts underneath from injury. The spasmodic contractions in tetanus not unfrequently cause great suffering over the abdomen. *d.* On the other hand, the abdominal muscles are occasionally paralysed, as the result of centric nervous disease. The movements of respiration are then altered in character; while the expulsive acts in which the abdominal muscles naturally take part are much interfered with.

4. Relaxed Abdominal Walls.—All the structures forming the walls of the abdomen are often in a relaxed and flabby state, yielding to any pressure from within, so that the abdomen becomes enlarged and prominent, especially if,

as is frequently the case, this condition is associated with much flatulence. It materially weakens the act of defæcation, and promotes constipation.

5. Inflammation and Abscess.—Local inflammation may be set up in any of the abdominal structures, and this may terminate in suppuration and the formation of an abscess. Purulent accumulations from within, as in cases of pelvic abscess, as well as certain abscesses originating in diseases of bones or joints, may likewise extend among the tissues of the abdominal walls, causing thickening and induration, or may make their way outwards, directly or through a sinus. Subsequently permanent sinuses or fistulæ may be left.

6. The abdominal wall may be the seat of *extravasation of blood*; and various kinds of *tumour* or *new growth* may form in its structures.

Frederick T. Roberts.

ABERRATION.—A divergence or wandering from the usual course or condition; applied in medicine chiefly to certain disorders of the mental faculties. *See* Insanity

ABORTION.—The *act of abortion* signifies the expulsion of the contents of the pregnant uterus before the seventh month of gestation. *An abortion* is a designation given to a fœtus prematurely expelled. *See* Miscarriage.

ABSCESS (*abscedo*, I depart). Synon.: Fr. *abces*; Ger. *Eiterbeule*; *Geschwür*.

Definition.—A collection of purulent matter, one of the results of inflammation. *See* Pus and Inflammation.

Pathology.—If the material which collects in a tissue as the consequence of inflammation softens and becomes liquid (suppuration), it does so either rapidly or slowly: if the former, the result is an *acute* abscess; if the latter, the abscess is termed *chronic* or *cold*. If the material thus softened and forming pus, often mingled with fragments of dead tissue, is limited by condensation of the parts around, which are usually consolidated by the products of inflammation, the abscess is said to be *circumscribed*; but if the surrounding parts in their turn soften, so as practically to offer no barrier to the pus, then the abscess spreads and is said to be *diffused*. In an *acute circumscribed* abscess the lymph which collects around it as the result of inflammation becomes organised and forms a sac (pyogenic membrane); and this, with the compressed tissue about it, is the wall of the abscess, consisting therefore of contents (pus), of a limiting sac, and of condensed tissue around. The resistance offered to the extension of the suppuration is greatest when the parts adjacent are dense and tough, such as bone and fascia; yet, as the pus in an abscess increases in quantity, probably by breaking down of the pyogenic layer, sufficient pressure is exerted to cause the most dense structures to yield, and an abscess will thus make its way even through osseous tissue. As might be expected, an abscess always advances in the direction of least resistance, and this extension is spoken of as its *pointing*. This pointing may be towards the surface of the body, but an abscess may direct itself towards a serous cavity, such as the peritoneum, or along a track of cellular tissue, as when pus beneath the deep cervical fascia points into the mediastinum. On the side at which the abscess is pointing, its wall, as the resistance lessens, projects; and by ulcerative absorption the parts covering it become quickly thinner, until they and the abscess-wall give way and the pus escapes. In by far the greater number of cases this absorption of tissue before the pointing abscess is towards the surface, and it is by ulceration of the skin that the opening for the discharge of the matter is effected. The wall of the abscess then contracts, pus continuing for a time to be discharged; and in the end, aided by the resilience of the tissues around, the sac of the abscess is obliterated, and the orifice through which its contents were discharged heals by granulation process. To ensure this result the walls must be left at rest, or the granulations which cover them will fail to unite, and the obliteration of the sac will not then take place, as happens for example in the case of an abscess situated between the moveable rectum on the one side and the ischium on the other, where the opposite abscess-walls are prevented from joining by muscular movements on the side of the bowel, and will only unite after such movements have been stopped by cutting across the muscular fibres which occasion them. The track which results from such failure of the healing of an abscess is called a *sinus* or *fistula*.

In a *diffused* abscess the inflammation of the parts around does not limit the suppuration by organisation of the effused lymph, but such lymph, itself degenerating, forms more pus, and so the abscess extends rapidly and widely, unless checked by some barrier of dense tissue. In this way matter often spreads along tracks of cellular tissue, as along the course of veins, and in the subcutaneous structures. An abscess when formed between bone and periosteum, or otherwise hindered from reaching the surface by pointing, also tends to diffuse itself by following the course of least resistance. In most of these cases by direct pressure upon the resisting tissue or by cutting off the blood supply (as of the skin when its subcutaneous tissue is infiltrated with pus), sloughing of the parts covering in the abscess ensues, oftentimes to a considerable extent, and so the pus eventually makes its way to the surface. It is these abscesses, spreading along tracks of tissue before they can reach the surface, which are apt, however, when involving certain parts, such as the course of some of the lumbar nerves, to burst into a serous cavity with fatal consequences.

A *chronic* abscess begins in some local inflammation without active symptoms, such as results in the deposit of aplastic lymph and subsequent ulcerative changes, as caries of bone, the irritation leading to suppuration. The formation of matter proceeds in a languid manner, so that it is only by slow degrees that it collects in any considerable quantity, although eventually these chronic abscesses may acquire great size. They slowly point, and in their tardy advance occasionally traverse even serous cavities, which have been first obliterated in the line of transit by adhesive inflammation of their opposed surfaces: in this way an abscess formed in the liver (and this holds good also for those of a more acute charac-

ter) may travel through the layers of the peritoneum, and may point through the anterior wall of the abdomen.

When an abscess discharges, its contents are seen to be either a thick yellow (*laudable*) pus, or pus stained with blood, or otherwise coloured, such as black or bluish-green; or the pus may be thin, almost watery, mingled with flakes of lymph; it may be inodorous or fœtid, or irritating to the touch (*ichorous*). Abscesses may also contain sloughs of tissue, or foreign bodies, or masses of inspissated pus, as hard occasionally as calculi, or fragments of dead bone, or calculi of various kinds. Sometimes a chronic abscess ceases to enlarge and if the irritation which occasioned it comes to an end, it may diminish by absorption of the fluid part of its contents, the solid drying up into a shrunken putty-like mass. It may remain in this state without giving rise to trouble, or it may become again the seat of suppuration by the formation of what under such circumstances has been termed by Sir James Paget a *residual abscess*.

The *progress* of any abscess is largely influenced by the state of the general health. In persons otherwise robust an abscess commonly runs an acute course; in those weakened by acute illness, such as scarlet fever or typhus, they form quickly, but are slowly recovered from, and severely tax by an exhausting discharge the powers of the patient. Persons in feeble health, hereditary or acquired, usually suffer from the chronic and diffused forms; and chronic affections of internal organs, as of the liver or kidneys, are not unfrequently associated with the development of such abscesses.

Ætiology.—The cause of an *acute* abscess may be an injury, such as a blow or pressure, as often happens in persons weakened by continued fever; exposure; or the irritation of a foreign body, or that of a poison introduced from without. In the last case the abscess is often diffused. Abscess running an acute course may also be due to a foreign body or to an irritant from within, as when it follows necrosis of a portion of bone, or the escape of urine into the tissues of the perineum. It also arises in connection with blood-poisoning, as in various fevers, and affections distinguished as septic. The cause of a *chronic* abscess is usually found in changes which go with deposits of a tuberculous character; or it is found in the changes which slowly occur around an irritating body, such as a renal calculus; or chronic inflammatory changes may culminate in one of these collections of matter. They may also form in parts which are long congested in connection with obstructed vein circulation (*varix*); and they may follow, or conditions closely allied may follow, the occlusion of a main artery and the consequent cutting off of the supply of blood to a particular region.

Symptoms.—The symptoms of an *acute* abscess are those of a local inflammation, with constitutional disturbance if the abscess is of any size; followed by a sense of cold or actual shivering, with increase of pain and swelling, tenderness, and throbbing. The tenderness can be recognised in the case of most abscesses; and, if pus is formed anywhere near the surface, the presence of the fluid is detected by its fluctuation. The severity of the pain is much influenced by the site of the abscess, as when the pus is held down and hindered from pointing by dense structures, such as fasciæ. Special symptoms may also arise in connection with the situation of the suppuration, as when urgent dyspnœa is caused by the pressure on the larynx of an abscess deeply seated at the base of the tongue. A *diffused* abscess, if subcutaneous, is recognised by its rapid spreading, and may be suspected if other signs point to a part as the site of the abscess in which diffusion is the rule, as, for instance, by the side of the rectum in the ischio-rectal fossa.

Of *chronic* abscess there is seldom in its early stage any evidence. The symptoms, if any, are those of failing health, and for the rest are marked by those of other changes from which the abscess is an outcome. Thus in disease of the hip joint or of the spine, unless an attack of shivering chances to attract attention, an abscess is not as a rule suspected until it has broken through its first limits, and has attained considerable size. It is not worth while to attempt to distinguish between chronic abscess and other swellings, such as extravasated blood or soft tumours, especially malignant tumours; for if a doubt in any case arises, it can be at once solved by the introduction of a grooved needle or of a fine trochar into the swelling. The true pulsation in an aneurism sufficiently tells its nature, and is not easily mistaken for the impulse sometimes given to an abscess by an adjacent artery.

Varieties.—The chief local varieties of abscesses which are likely to be met with in medical practice may be thus arranged:—1. Subcutaneous or more deeply seated abscesses in the limbs, in connection with low fevers, erysipelas, pyæmia, &c. 2. Abscesses of local origin in the walls of the abdomen or chest. 3. Abscesses originating in serous membranes. 4. Certain special abscesses associated with diseased bone, *e.g.*, psoas and lumbar abscess. 5. Abscesses formed in the cellular tissue around organs, *e.g.*, peri-nephritic, peri-cæcal, &c. 6. Abscesses originating in inflammation of organs, the chief of which include hepatic, renal, pyelitic, pulmonary, mammary, cerebral, splenic, pancreatic. 7. Obscure abscesses formed in the deep cellular tissue, *e.g.*, retro-pharyngeal, ischio-rectal, mediastinal. 8. Glandular abscesses, which are usually chronic and of a scrofulous nature.

Treatment.—The treatment of an *acute* abscess consists in rest, soothing local applications, and the use of remedies to allay pain and constitutional disturbance, if the latter exists. As soon as the presence of pus is recognised the abscess must be opened, if possible where the matter is most dependent; and as soon as its contents have escaped all troublesome symptoms will usually disappear. The opening is needed to relieve pain, and to prevent in some cases diffusion, and sometimes to relieve urgent distress, as when dyspnœa is caused by the pressure of an abscess upon the air-passages. It is also desirable to open an abscess to avoid the considerable scar which must result if the matter is left to escape by ulceration and sloughing of the superficial tissues. If it is important to

avoid the scar of an incised wound, an abscess may be punctured in several places with a grooved needle, when the punctures, if kept open, will effectually drain off the pus, and the marks left will in the end be scarcely discernible. In most cases, however, it is necessary to open an abscess by an incision: a narrow double-edged knife should be used; and if the matter is deeply seated, the superficial parts only need be cut, the deeper being torn through, as Mr. Hilton recommends, by dressing forceps: the risk of dividing important structures, as in the neck, is thus avoided. After the pus has escaped, the wound should be kept open by means of a drainage tube (unless the abscess is of insignificant size), which is conveniently made by introducing a twisted slip of thin gutta-percha tissue or of oiled silk, and should be covered with carbolised oil on lint, or with a poultice of linseed and ferralum. Some surgeons protect the wound whilst operating by means of the carbolic spray or by a piece of linen steeped in carbolic lotion (1 in 20), or take other antiseptic precautions. The drainage tube should be withdrawn after the first day if the abscess is superficial, but if the pus has been deeply seated it should be only gradually withdrawn, portions being cut off as the abscess contracts. If a foreign body has caused the formation of the abscess, it must be sought for and removed before the suppuration can be expected to cease. Occasionally the vascular wall of an abscess bleeds freely, or a vessel is opened in the progress of the affection: the hæmorrhage usually ceases on laying the abscess freely open; but if this does not suffice it may be permanently controlled by pressure, and the cases are rare in which further operative interference is called for. Inflammation of the sac used not infrequently to follow the discharge of its contents, but under the treatment now employed such an occurrence is unknown. During the healing of any considerable abscess the general health should be attended to, and tonics and change of air may be useful to expedite recovery.

Diffused abscesses, whether subcutaneous or more deeply seated, require free incisions as soon as suppuration is even suspected, so as to avoid the damage which results from their spreading and from the sloughing of tissue, as of the skin, which will otherwise occur, especially with those due to poison introduced into the system or those caused by infiltration of urine. These abscesses sometimes lead to fatal results.

A *chronic* abscess may have its contents drawn off by the aspirator; or it may, when it has come near the surface, be opened, drained, and dressed with carbolised oil on lint, without any risk of constitutional disturbance, but its ultimate closing will depend upon the removal of the cause; if, for example, it is due to disease of a joint, it cannot be cured until the disease in which it has originated has in some way ended.

Sinus.—An abscess after being opened may contract until it forms a narrow track, *sinus* or *fistula*, leading to the site of primary irritation. Such a track has a dense fibrous wall from which muco-purulent fluid escapes: it may also convey secretions, as from the liver (*hepatic fistula*) or stomach (*gastric fistula*), or excretion, as from the kidneys; or it may simply carry out the pus which forms around some irritant at the deep extremity, such as a foreign body, a portion of carious or of necrosed bone. Some such fistulæ are due to the movements of adjacent muscles preventing union of the abscess walls. Unless the cause of the sinus can be removed, as by extracting necrosed bone, these fistulous tracks are difficult to manage, requiring especial treatment according to their situation. Other *fistulæ* are those forming communications between mucous canals (*recto-vesical, vesico-vaginal fistulæ*), and these need special treatment, such as plastic operations and operations diverting the course of excreta escaping through unnatural channels.

The tissue about healed abscesses, scar-tissue generally, and tissue spoiled by inflammation, are apt on slight provocation to inflame and suppurate, and to those collections of matter the term '*residual*' has been applied. The treatment of such abscesses in no way differs from that of others, and they usually heal in the ordinary manner. G. W. Callender.

ABSINTHISM.—Definition.—The condition induced by the undue imbibition of absinthe.

From the mode in which absinthe is taken, we should expect that the symptoms induced by its excessive consumption would be generally obscured by, and intermixed with those of alcohol (*see* Alcoholism). That it has a special effect on the organism, and that this may be diagnosed from alcoholism, has been pointed out by Motet, Magnan, and other French physicians; and the writer last-mentioned has clearly exemplified its action by numerous experiments on dogs. In persistent absinthe-drinkers vertigo and epileptiform convulsions are marked symptoms, and come on much earlier than when alcohol in other forms is habitually drunk. Hallucinations occur also without any other symptom of delirium tremens; and, when tremors coexist, these are limited more particularly to the muscles of the arms, hands, and upper extremities. Absinthe acts chiefly on the cervical portion of the spinal cord, and this readily explains the special symptoms arising from its regular use. John Curnow.

ABSORBENT AGENTS.—Definition.—In *Surgery*, absorbents are substances used to absorb fluids, as sponges, charpie, or tow: in *Medicine*, drugs which neutralize excessive acidity in the stomach—a synonym for alkalis (*see* Alkalis). The term is sometimes also made use of to designate remedies, such as the preparations of mercury and iodine, which are believed to possess the property of promoting the absorption of morbid products.

ABSORBENT VESSELS and GLANDS, Diseases of. *See* Lymphatic System, Diseases of; also Bronchial, and Mesenteric Glands, Diseases of.

ACARUS.—*Acari* or *Mites* constitute an order of the class *Arachnida*, several species of which are parasitic. The *Acarus scabiei* or *Sarcoptes hominis*, and the *Acarus folliculorum*, or

more properly the *Steatozoon folliculorum*, are the only human parasites belonging to this family.

DESCRIPTION. — 1. The ACARUS SCABIEI is a small roundish animal, just visible to the naked eye. Examined under the microscope it is seen to be flattened and to resemble a tortoise in shape; when fully developed it has eight legs, and on its under surface are scattered filaments and short spines, which are for the most part directed backwards. The female is larger than the male, and is provided with terminal suckers on the four anterior legs, while filaments occupy a similar position on the posterior ones; in the male, however, the two extreme hind legs have suckers like those on its fore limbs. The young *Acarus* has only six legs, the two hindmost ones, which are distinctive of the sex, being wanting; it acquires these after shedding its first skin. The male *Acarus* lives near the surface of the skin, while the female burrows within the cuticle, and deposits from ten to fifteen eggs in the cuniculus or burrow; these eggs hatch in about a fortnight. The young *Acari* escape from the burrow, but the parent does not leave it, and dies when she has finished laying eggs. The *Acarus scabiei* is the cause of the skin-affection termed *Scabies* or *Itch* (*see* SCABIES).

2. The ACARUS FOLLICULORUM is a very minute parasite commonly found in the sebaceous and hair follicles of the face, but its presence can hardly be regarded as indicating disease. In this animal the head is continuous with the thorax, and to the latter are attached eight very short legs, each armed with three strong claws. On each side of the head are short jointed palpi. The abdomen varies in length from twice to three or four times that of the thorax: it is pointed at its distal extremity. The presence of this parasite in the follicles of the skin is quite unimportant. ROBERT LIVEING.

ACCOMMODATION, Disorders of.—*See* VISION, Disorders of.

ACEPHALOCYST (ἀ, priv.; κεφαλή, a head; and κύστις, a bladder).—A headless cyst or hydatid.—This term was formerly much employed to distinguish the true hydatid from all those bladderworms that are furnished with a head visible to the naked eye. The expression is a misnomer and should be abandoned, since it is only fairly applicable to such hydatids as have failed to develop the so-called heads internally. The *Acephalocystis endogena* of John Hunter and the *A. exogena* of Kuhl are merely varieties of the true hydatid (*Echinococcus veterinorum*, or *E. hominis*). *See* HYDATIDS, ECHINOCOCCUS, and BLADDERWORMS. T. S. COBBOLD.

ACHOLIA (ἀ, priv., and χολή, bile).—Absence or deficiency of bile. *See* BILE, Morbid states of.

ACHOR.—A small follicular pustule of the scalp. Willan's definition is as follows:—'A small acuminated pustule containing a straw-coloured matter, which has the appearance and nearly the consistence of strained honey, and is succeeded by a thin brown or yellowish scab.' Both the pustule and the scab are constituents of the disease *Porrigo*. The word has fallen into disuse, but is preserved by Schönlein in the name 'Achorion' assigned by him to one of the varieties of parasitic cutaneous fungi. The Greek word ἀχώρ signifies scurf, or dandruff; ἀχυρὸν meaning chaff. ERASMUS WILSON.

ACHORION (ἀχώρ, scurf) is the name given to one of the three principal dermophytes or epiphytes of the skin. It is the constituent of the crusts of Favus (Achor), and belongs to the group of fungoid plants denominated *Oidium*. It consists of spores, sporidia or tubes filled with spores, and empty branched tubes or mycelium.

Achorion was the first discovered of the epiphytes of the skin, and in compliment to one of its early observers, Schönlein, has been named *Achorion Schönleinii*. It is supposed to be the agent of contagion in Favus; it has also been found in the loose cell-structure beneath the nail in Onychogryphosis. ERASMUS WILSON.

ACHROMA (ἀ, priv., and χρῶμα, colour). Absence of colour; an achromatous or colourless state of an usually coloured tissue, due to absence of pigment. In reference to the skin Achroma is synonymous with Leucoderma, Albinism, and Alphosis. *See* PIGMENTARY SKIN-DISEASES.

ACHROMATOPSIA (ἀ, priv.; χρῶμα, colour; and ὤψ, sight).—More or less complete inability to distinguish colours from each other. *See* VISION, Disorders of.

ACIDITY.—Acids are constantly passing out of the body by the lungs, the skin, and the kidneys. These acids, if we except the small quantity introduced from without in the form of acid salts of certain articles of food, are formed within the body by the disintegration and oxidation of the tissues and food. If the oxidation of organic substances in the system were complete, the sole products of their combustion would be carbonic acid, water, and urea; but as this oxidation is never actually complete, other products, as lactic acid, oxalic acid, uric acid, etc., are formed; and the increased or diminished production of these intermediary products may be regarded as the measure of the completeness with which the oxidation processes are being performed in the body. The quantity of acid matter passing through the blood on its way to the lungs, the skin, and the kidneys is considerable; since it has been shown approximatively, that a healthy man of eleven stone weight, under ordinary circumstances, passes by the two first channels an average of 890 grammes (about 28 ounces) of carbonic acid daily, and that the acid excreted by the kidneys in the same period is equivalent to two grammes (about 31 grains) of crystallised oxalic acid; whilst the volatile fatty acids passing off with the sweat have not yet been satisfactorily calculated. It is evident that if the regular elimination of this acid, by any of these channels, be interfered with, it will tend to accumulate in the system. Acidity, or excess of acid in the body, therefore depends on two causes:—1. *Excessive formation*, the result of incomplete oxidation of the elements of the tissues and the food. 2. *Deficient elimination* of acid formed either in normal or abnormal quantities. Both these causes, however, are generally found acting in conjunction. Oxidation is imperfectly performed, when an insufficient quantity of oxygen

is introduced into the body, owing to insufficiency of the respiratory act, the result of disease or of sedentary habits; or when the blood is poor in red corpuscles, the carriers of oxygen, as in leucocythæmia; or from functional derangement of some large gland, as the liver, where oxidizing processes are extensively wrought. Again, the materials submitted to the influence of the oxygen within the body may be so increased, as is the case in febrile conditions, or in general plethora induced by over-feeding and insufficient exercise, that the supply of oxygen may prove insufficient for their complete combustion. Defective elimination of the acids formed within the body is due either to diseased conditions which prevent, or to want of the physiological stimulus which excites, the lungs, skin, and kidneys to exercise their respective functions properly. It will be seen, therefore, that acidity may arise in consequence of the disturbing influence of disease; or may be acquired or inherited as the penalty of transgression of certain laws of health—as the result of unfavourable hygienic conditions. In the former case, acidity is only secondary, and is generally subordinate to the disease producing it, and has rarely to be considered apart from it; whilst in the latter instance acidity is usually at first the only trouble, leading, however, if disregarded to secondary mischiefs.

Effects.—The mucous membranes and skin chiefly suffer in acidity. The former become subject to catarrh, produced, no doubt, by the irritating presence of the acid. Acidity may thus cause bronchitis, gastro-intestinal catarrh, and catarrh of the genito-urinary tract. Sometimes the acid is poured out in such quantities from the mucous membrane of the stomach as to be ejected from the mouth. In these cases digestion is considerably interfered with by the too acid condition of the gastric juice. Sometimes, however, this acidity of the stomach is produced by an opposite condition—the deficiency of the digestive fluid, and consequent acid fermentation of the food. Abnormal acidity of the urine produces not only catarrh of the urinary passages, but by decomposing the salts of uric acid causes a deposit of insoluble uric acid in the passages, thus giving rise to attacks of gravel or leading to the formation of a calculus. Acidity manifests itself in the skin by attacks of erythema, herpes, eczema, and urticaria. Rheumatism, too, may be considered as a disease resulting from the formation of acid, affecting chiefly fibrous and serous membrane; no one can witness the enormous quantities of acid sweat poured out, and the highly acid urine, in the acute form of this disease, without acknowledging that an increased formation of acid is taking place somewhere in the body; though perhaps unwilling to commit himself to accept any of the views hitherto advanced as to the nature of the acid.

Estimation of Acid.—For clinical purposes an estimation of the acidity of the urine furnishes the physician with an approximate clue as to the amount of acid formed in and passing out of the body. This is done by collecting the urine for twenty-four hours, placing 100 c.c. of this in a beaker, and then adding a solution of sodium hydrate, standardised so that 1 c.c = ·01 gramme of crystallised oxalic acid, from a Mohr's burette, till the fluid is neutralised; the number of c.c.'s of the standard solution required to effect this is to be multiplied by ·01, which gives the percentage acidity in terms of oxalic acid; to ascertain from this the total amount of acid in the twenty-four hours' urine is only a matter of calculation. Too much dependence must not, however, be placed on the urine as a means of estimating excess or deficiency of acid in the system; it sometimes happens that in highly acid conditions the urine is alkaline. This, as Dr. Bence Jones has shown, may occur when large quantities of acid fluid are poured out of the stomach; and Prout long ago observed, that in the eczema of gouty persons the urine, so long as the disease persisted, was either of low acidity or alkaline, but that the subsidence of the eczema was frequently followed by an over-acid condition of the urine, accompanied with renal and vesical catarrh.

Treatment.—The general indications for the treatment of acidity consist in the promotion of oxidation, and the elimination of the acids formed. Active habits, which promote the pulmonary and cutaneous functions, should be encouraged. The diet should be just sufficient to meet the physiological requirements of the body; it should consist chiefly of fish, fowl, game, and eggs; saccharine and farinaceous articles being excluded. Sweet and cheap wines should be avoided; for those who cannot afford to purchase good wine, pure spirits and water is the best substitute. Carlsbad salts or Friedrichshall water may be given if there is much abdominal plethora; the habit of taking mercurials as a relief for this condition is to be deprecated. Alkaline medicines are frequently administered with a view of neutralising the effects of acid; their employment for this purpose seems, however, questionable. Dr. Parkes has stated that the administration of bicarbonate of potash (a favourite remedy in acid diseases), though rendering the urine alkaline, in reality increases very largely the excretion of the organic acids. This is not to be wondered at when we consider that the bicarbonate, although alkaline in reaction, is in constitution an acid salt. The nitric and hydrochloric acids, given in moderate doses about one hour before meals, certainly have a powerful oxidising effect, and diminish the quantity of uric acid excreted in the urine. In cases where the acidity is manifestly due to defective oxidation consequent on poverty of blood from diminution of the red corpuscles, iron and food must be freely given.

ACIDS. — Definition. — Substances which combine with alkalis, and destroy their power of turning red litmus paper blue. Most of the acids also redden blue litmus, and have a sour taste; but some, for example, carbolic acid, possess neither of these properties.

Enumeration.—Acids may be divided into *Inorganic* or *Mineral*, and *Organic*. The mineral acids used in medicine are Carbonic, Hydrochloric, Nitric, Nitrohydrochloric, Phosphoric, Sulphuric and Sulphurous acids. The organic acids thus employed include Acetic,

Benzoic, and Carbolic, Citric, Gallic, Hydrocyanic, Lactic, Salicylic, Tannic, Tartaric, and Valerianic.

Action.—The stronger acids—Sulphuric, Nitric, Hydrochloric, and Glacial Acetic acids—destroy animal tissues, and act as caustics when applied to the surface. When swallowed, they produce the symptoms of irritant poisoning. (*See* Poisons.) An antidote for these poisons which is always at hand is carbonate of lime, in the form either of whiting or of plaster chipped from the nearest wall. Other antidotes are alkaline carbonates and bicarbonates, milk, oil, and soap. Diluted acids, taken into the mouth, increase the secretion of saliva; and hydrochloric acid forms an important constituent of the gastric juice, without which digestion does not go on. When absorbed into the blood, dilute acids act on the heart generally, slowing its pulsations and reducing the temperature. They are excreted in the urine and milk.

Uses.—Nitric acid is employed as a caustic application to piles, to poisoned wounds, and to spreading or unhealthy sores. Glacial Acetic acid is used to destroy corns or warts. Diluted Acetic acid or vinegar is applied as a lotion to relieve headache; to allay the itching of prurigo, lichen, and psoriasis; to check perspiration; and sometimes to hasten the appearance of exanthematous eruptions. Diluted acids, especially Citric, Tartaric, and Hydrochloric, are administered in fevers as refrigerants, because they relieve the dryness of the mouth, and diminish the thirst by increasing the secretion of saliva, as well as lower the temperature and pulse-rate. Under the like circumstances, the organic acids, Acetic, Citric, and Tartaric, when combined with alkaline carbonates in a state of effervescence or otherwise, form agents which act on the skin and kidneys. In febrile conditions, anæmia, and some forms of dyspepsia, the proportion of acid in the gastric juice is insufficient for the proper digestion of food, and the administration of dilute Hydrochloric acid, immediately before or after meals, is useful both by aiding digestion and by preventing the formation of butyric and other acids, which give rise to sour eructations. Nitro-hydrochloric acid, before meals, is likewise beneficial in preventing acidity. It appears to have some action on the liver, and is used both internally and externally as a lotion or footbath in jaundice and biliousness. It generally relieves the frontal headache common in young females, which is felt just above the eyebrows, and not accompanied by constipation. Dilute acids, especially Aromatic Sulphuric acid, are useful in checking diarrhœa, colliquative sweats, hæmorrhages, and mucous discharges. By lessening the alkalinity of the urine, they tend to prevent the formation of phosphatic calculi, phosphoric and nitric acids being most frequently employed for this purpose. Care must be exercised in their administration to nursing mothers, as they are excreted in the milk, and sometimes cause griping and diarrhœa in infants at the breast. Several acids have a special action of their own, and are considered under their respective groups, such as Hydrocyanic acid, which is a sedative; Carbolic, an antiseptic; Salicylic, an apyretic; Gallic and Tannic, astringents. T. Lauder Brunton.

ACINESIA (ἀ, priv., and κίνησις, motion).—A synonym for paralysis of motion, whether partial or general. *See* Paralysis, Motor.

ACNE (ἀκμάζω, I bloom).—The ancient Greeks showed their appreciation of the morbid states of the integument by calling this disease ἀκμαί, the *flos ætatis* of their Latin translators; but in course of transmission the μ gave place to ν, and the original term to that by which the disease is at present known.

Definition.—An inflammation of the hair follicles, or a folliculitis of the skin, associated with the development of the permanent hair of the body at and after puberty; its almost exclusive seat of manifestation being the face, the submastoid region of the neck, the sternal region of the breast, and the back and shoulders.

Ætiology and Pathology.—In its relation to other diseases of the skin, Acne is nothing more than a folliculitis; and folliculitis, however engendered, must always pursue the same pathological course. Hence folliculitis of the face, from whatever cause, especially if attended with papulation and suppuration similar to the acne of puberty, has likewise been termed *Acne*; such is the *Acne Rosacea* or *Gutta Rosacea* of adult life; and such are the varieties of folliculitis produced by iodine, bromine, and tar, which have been respectively denominated Iodine-, Bromine-, and Tar-Acne.

Description.—The pathological essentials of Acne are:—a languid and torpid skin; a tendency to accumulation of sebaceous matter within the follicles; congestion of the coats of the follicles and immediately contiguous structures; and the ordinary manifestations of inflammation, such as suppuration, infiltration, and solidification. From these, which are the ordinary signs of inflammation of the follicles, we derive the various subjective designations of the disease: for example, when accumulation of sebaceous matter, showing as a black point with little or no inflammation, is the leading feature, the condition is termed *Acne punctata*; when congestion and infiltration force up the skin into a conical pimple, *Acne coniformis*; when suppuration is present, *Acne pustulosa*; and when thickening and condensation display themselves, *Acne indurata*. The whole series, with the exception of *Acne indurata*, which represents a chronic disposition, may be called indiscriminately *Acne simplex* or *Acne vulgaris*, there being obviously no regular standard.

Diagnosis.—Acne is a well-defined eruption, and not difficult of diagnosis, its most important features being:—its limitation to the period of life corresponding to and soon after puberty; and its dependence on a physiological process at that time taking place in the economy.

Treatment.—The treatment of Acne may be summed up in a few words:—Remove any exciting cause that may exist; improve the nutritive power of the individual and of the skin; stimulate, that is, give tone and vigour to the part locally. Our best general remedies are a

good hygiene, careful attention to diet and habits of life, ordinary tonics, and especially arsenic. The most efficient local application is sulphur, especially the compound hypochloride of sulphur ointment, which consists of a drachm of hypochloride of sulphur with ten grains of carbonate of potash, to an ounce of benzoated lard. Arsenic is best administered as a combination of Vinum Ferri and Liquor Arsenicalis (mij–iij) three times daily at the end of meals.

ERASMUS WILSON.

ACONITE, Poisoning by.—*See* POISONS.

ACQUIRED DISEASES.—Diseases originating independently of hereditary transmission. *See* DISEASE, Causes of.

ACROCHORDON.—An outgrowth of the integument in the form of a slender cylinder, which may be compared to the loose end of a piece of string or cord—ἄκρον signifying a point or end and χορδὴ a string. Such outgrowths are usually met with in a feeble state of the skin, and particularly in elderly persons, their common seat being the neck or trunk. They are at first sessile, but become elongated; and are sometimes bulbous at the extremity, and more or less pedunculated. Pathologically an acrochordon is composed of loose areolar tissue, firmer at the surface than within, and of a fine artery and vein, connected by a capillary loop or plexus, and sometimes a little ramified. It is popularly regarded as a wart, and in medical works is termed *verruca acrochordon*, but it differs from a wart very widely in structure. When acrochordones attain a size beyond that of a pea, they fall into the category of a soft tegumentary tumour or Molluscum.

TREATMENT.—This consists in snipping them off with scissors, or touching them with a strong solution of potassa fusa (equal parts). When numerous and minute, they admit of being shrivelled up and removed by means of liquor plumbi, or a lotion of perchloride of mercury, two grains to the ounce. The latter, by its stimulating property, also arrests their formation.

ERASMUS WILSON.

ACRODYNIA (ἄκρος, extreme, and ὀδύνη, pain). A dermatitis affecting the hands and feet, particularly the palms and soles, accompanied with burning heat, stinging and smarting pains, and numbness. The pains sometimes extend to the whole system, and there is more or less disorder of the digestive and assimilative functions. The redness is at first bright, then deeper tinted and brown, with considerable pigmentation of the rete mucosum. Occasionally there are pimples, pustules, and blisters; the cuticle desquamates, and is sometimes cast in a single piece; the disease running on for several weeks.

TREATMENT.—This should be directed to the regulation of the digestive and assimilative organs, and to the relief of local inflammation by means of water-dressing followed by bandaging with zinc ointment. ERASMUS WILSON.

ACUPUNCTURE is an ancient mode of treatment for the relief of painful affections, now but little used, consisting in the introduction of fine round needles through the skin, to a varying depth. It is said to have been introduced into this country from China or Japan, about 200 years ago The needles used are about two inches in length, and are set in round handles, so that they can be introduced with a gentle rotatory movement. It is now employed solely in lumbago and sciatica, in which affections it undoubtedly gives relief. The operation is thus performed. The patient being laid upon his face, tender spots are sought for—in lumbago over the erector spinæ, and in sciatica along the course of the sciatic nerve. The needles are then pushed in vertically for a depth of from one and a-half to two inches, and allowed to remain for from half an hour to two hours. The number of needles employed may vary from one to six. In sciatica it is recommended, if possible, to make the needle actually penetrate the nerve. This is known by the patient complaining of sudden pain shooting down the back of the leg. The mode of action is uncertain, but in sciatica it has been supposed that the puncture of the nerve sheath allows the escape of fluid. Acupuncture has also been employed in painful neuritis following injury, but without much effect. In a modification invented by Baunscheidt, forty punctures, about half-an-inch in depth, were made in an area of the size of a crown piece, by an instrument working by a spring. Oil of mustard diluted with olive oil was then painted on, which gave rise to an eruption like herpes. This was at one time in great repute as a quack remedy for all sorts of diseases. The term *acupuncture* is also applied by some to the introduction of needles into a cyst, in order to allow the fluid contents to escape, as in the treatment of ganglion, of hydrocele in infants, or of hydatid cyst of the liver. Puncture of the skin for the relief of œdema or subcutaneous emphysema is sometimes called by the same name. For this purpose the ordinary three-cornered acupressure needle is more convenient than a round acupuncture needle, as the puncture resulting from it allows fluid to escape more readily.

MARCUS BECK.

ACUTE.—This word, when associated with a disease, signifies that such disease runs a more or less rapid course, and is generally attended with severe symptoms. It is also employed to express intensity of a particular symptom, as, for example, pain.

ADDISON'S DISEASE. SYNON.: *Morbus Addisonii*; *Bronzed Skin Disease.* Fr. *Maladie d'Addison*; Ger. *Addisonsche Krankheit.*

DEFINITION.—In his original memoir on this subject, Dr. Addison wrote—'The leading and characteristic features of the morbid state to which I would direct attention are anæmia, general languor and debility, remarkable feebleness of the heart's action, irritability of the stomach, and a peculiar change of colour in the skin occurring in connection with a diseased condition of the supra-renal capsules.'

In reality, the general symptoms of the disease, as given above, outweigh in importance any pigmentary change whatever: and it

is quite possible for the disease to run its course without any unusual deposit of pigment in any part of the body.

Addison's disease might, however, be defined as 'a constitutional malady characterised by great weakness and anæmia, with deposit of pigment in the skin and some other parts of the body, and accompanied by or depending on a specific morbid change in the supra-renal capsules.'

Ætiology. — The constitutional or general nature of the malady must ever be borne in mind, though some of its factors are strictly local; but, though constitutional, it is not transmissible either (*a*) by contagion or infection, or (*b*) by inheritance. If, however, Addison's disease itself is never an inherited malady, it is in very many cases associated with a highly hereditary constitution, that of the tubercular or scrofulous type, and in such individuals accidents like falls or blows, which would fail to make an impression on stronger men or women, may suffice to set the morbid process in motion. In not a few instances the bodies of the subjects of this disease have been found perfectly healthy apart from the morbid change in the supra-renal capsules characteristic of the malady; and, in a certain number of cases, local abscesses seem to have been the starting-point of the specific changes in the capsules themselves. Addison's disease is, moreover, essentially one of early adult life, the great majority of cases occurring between fifteen and forty. It is much more frequent in men than in women, and seems, in a great measure, to be confined to the working classes.

Symptoms.—It is not at all times nor in all instances an easy task to make out a perfect clinical history in a case of Addison's disease. The earlier symptoms are often so indefinite and so insidious that it may not be until the disease is fully developed that the patient seeks medical aid, and by that time the symptoms are usually unmistakeable. It is different when the malady apparently originates in a fall or a blow, but even such a starting-point as this may only be sought for late in the history of the disease.

The mischief may be said to commence in most cases with a feeling of general weakness and of being unwell; the discolouration of the skin usually appears later, but may be the first prominent symptom. In a small number of cases the onset may be acute, with loss of appetite, sickness, headache, pain in the epigastrium, sometimes also vomiting and diarrhœa. When the disease has attained its full development the characteristics of the malady are most striking. Then the downcast, mournful look, the drooping shoulders and stooping gait, the arms hanging helplessly by the sides, and the slow and listless movements of the patient are strikingly impressive. If to this be added the darkening of the skin, the clear and pearly conjunctiva, and the breathlessness on exertion, we have almost all that meets the eye when such a patient presents himself. But to these, on enquiry, other important symptoms are easily added. The breathlessness will be found to be partly due to anæmia, partly to impaired innervation. From the same causes in part, but not entirely, we find a quiet, feeble action of the heart, readily giving place to palpitation. With these are usually associated pain and tenderness in the epigastrium and hypochondria, irritability of the stomach and nausea giving rise to retching, and frequently obstinate vomiting. Such modifications of breathing as sighing, yawning, or hiccup, are frequent. Again, from the anæmia, there is a strong tendency to giddiness and syncope, which last increases as the disease wears on, and, in many cases, carries off the patient when raising himself, or being raised in bed for the purpose of taking food or performing other necessary functions. This is not the invariable mode of death, for nervous symptoms, such as coma or convulsions, may usher in the final scene. When the prostration is great, the patient may be for some time before death apparently unconscious, but this is simply due to unwillingness to make the slightest exertion, owing to his profound weakness.

Throughout the whole disease the bodily temperature is diminished (97°–98° Fh.) rather than increased, and this is often markedly the case towards the close of the disease, though then it has been noted as high as 100·8° Fh.

From the above sketch it is plain that the two most prominent factors in the disease, as presented during life, are—

1st. General weakness and anæmia.

2nd. Abnormal deposit of pigment in various parts of the body.

1. To the former of these is to be referred (*a*) the loss of muscular power, as evidenced by diminished muscular energy and force both in the voluntary and involuntary muscles, for the heart's action is feeble and imperfect, and the bowels are usually confined. (*b*) At once a cause and consequence of the weakness and anæmia are loss of appetite, sickness and vomiting, though these, too, depend in part on other morbid changes; whilst, lastly (*c*), imperfect nutrition of the nervous system results, notably of the brain itself, whence arise vertigo, numbness, dimness of sight, deafness, tremors, and the like. The pain in the epigastric and hypochondriac regions is probably due to local causes.

2. The deposit of pigment is peculiar and characteristic. It is not uniform in disposition, and varies greatly in tint. It may only amount to a light brown or smoky discoloration in certain parts, or it may assume the appearance of a dark olive-green hue, approaching to black in some situations, especially over the genitals and nipples. Elsewhere it is most abundant on the face, where it often seems to begin, on the neck, the backs of the hands, the folds of the legs, and along either side of the linea alba. A striking peculiarity is that the conjunctivæ are clear and pearly, and that the nails are never discoloured. On the other hand, there is a great tendency to the deposit of pigment where the skin has been irritated or the epidermis removed, as by a mustard poultice or blister; but the skin is always smooth and supple. In a typical case under the writer's care, blisters had been applied to the chest for the uneasy feeling experienced there, and here the pigmentary tint was deeper than in any other part of the body, save the genitals. Cicatrices affecting the whole

depth of the skin do not seem to be so pigmented. The mucous membrane of the mouth not unfrequently becomes the site of pigmentary deposits. These are not diffuse, but, when the lips are affected, they usually take the shape of smears or lines. On the insides of the cheeks blotches or irregularly-defined spots are most common, as well as on the sides and root of the tongue. The latter spots are commonly better defined than are the others, and somewhat resemble the small well-marked black spots occasionally observed in parts already pigmented.

The site of this pigmentary deposit is in the growing layer of the epidermis, the usual site of colour in all races of mankind, and which is usually known as the *rete mucosum*; but occasionally pigmentary granules are to be found deeper, in the cells of the true skin.

An interesting clinical fact has been brought out by Dr. Greenhow, which will, probably, be noted in a considerable proportion of cases. This is the mode in which the disease progresses. Often it presents periods of remission, only to be followed by a more marked advance; but, notwithstanding these remissions, the progress is invariably towards a fatal termination. The time occupied in this progress varies much; it may be weeks or months, or it may be years, but in all well-defined cases the result is the same.

Pathology.—From the earliest description of the morbid state known as Addison's disease, the malady has been associated with disease of the supra-renal capsules. At first it was supposed that any form of disease affecting these organs must give rise to a similar train of symptoms, and some of the investigations carried on with a view to sustain this position sound absurd enough by the light of subsequent experience. Gradually it has been made clear that only one kind of lesion is accompanied by the specific symptoms just detailed. Briefly, the morbid changes are as follows:—

Normally, the supra-renal capsules consist of two parts, a cortical and medullary, differing greatly in their structure. In Addison's disease both are superseded by a new structure, which is to be seen in various stages. In the earliest of these the capsules are invaded by a kind of translucent material, which is sometimes almost cartilaginous in its hardness, and which, when examined under the microscope, resolves itself into a kind of very finely fibrillated or trabecular connective tissue, with corpuscles like leucocytes freely congregated in the interstices of the meshwork or between the fibres. This material, when seen in bulk, is grey or greenish-grey, afterwards becoming red on exposure. With it is mixed up an opaque yellow substance, varying in amount and apparently more abundant the more advanced the disease. In the earlier stages it presents the appearance of nodules embedded in the translucent material, but later almost the whole of this last may have disappeared, and the yellow opaque matter become converted into a thick creamy fluid, a putty-like substance, or even one or more cretaceous masses. This opaque material, then, is evidently, from its first appearance, indicative of fatty degeneration, and closely resembles in every respect what used to be known as yellow or crude tubercle.

The exterior of the capsules presents certain important features. The capsules themselves may be large or small, according to the stage of the disease and the nature of their contents, but, even when they are small, it may be safely assumed that at one time they were enlarged. In all cases they will be found closely and strongly adherent to neighbouring structures. Some of these structures are of great importance: for example, the semi-lunar ganglia, and the vast plexus of nerves associated therewith, in which important changes have been found. These pathological conditions have been so often observed and so carefully noted, that they cannot be looked upon as accidental concomitants of the diseased process, but rather part and parcel of it, and, in all probability, as giving a clue to some of the most marked phenomena of the malady. Broadly it may be said that these changes consist in a great thickening of the connective tissue surrounding the nerve-fibres and the ganglion-cells, giving rise to something like compression and ultimate destruction of the nerve cells and fibres. This occurs both in the cerebro-spinal nerve fibres and in those more intimately connected with the ganglionic system. The nerve-cells, moreover, are not unfrequently deeply pigmented.

These, so far as is known, constitute the main pathological elements of Addison's disease. It does not arise from mere destruction of the supra-renal capsules, for then it would be seen under other conditions, as when cancer of a neighbouring organ extends to and involves the supra-renals; but no Addison's disease follows this event. The exact mode in which these nerve lesions give rise to the characteristic symptoms of the disease are, as yet, matters of speculation, and not of exact science; and it may be said that our knowledge of the whole of this subject is yet in its infancy.

Though these are the main facts relating to the pathology of Addison's disease, there are still others of some importance. Pigmentation has been sufficiently noticed, but its origin has not been discovered. Without doubt the pigment, like other animal pigments, is derived from the blood, and this has been examined with a view to discover any change in its composition which would explain the darkening of the skin, but without result.

In making the section of the body of one who has been the subject of Addison's disease, one cannot help being struck with the amount of subcutaneous fat, especially over the abdomen, as contrasted with the difficulties of nutrition under which the patient suffered; yet a considerable quantity is almost always found. But more closely connected with this malnutrition are certain changes in the absorbent system along the digestive tract. These consist in enlargement of the solitary and agglomerated glands constituting Peyer's patches, and of the mesenteric glands; as well as of lymphoid deposits in the mucous membrane of the stomach which give rise to little projections, termed *mammillations*, on the walls of that organ, especially

near the pylorus. Small ecchymoses are also not unusually found in the same situation. Of other organs it may be noted that the liver and spleen are often enlarged and hyperæmic, and the heart small and light.

Diagnosis.—There would have been less difficulty or doubt in the diagnosis of Addison's disease, had it been clearly enunciated from the first that a bronzed skin did not alone constitute the malady. The disease rests on a threefold basis—*general weakness, diseased suprarenal capsules*, and *bronzed skin*, the last being the least important of the three. There may be darkening of the skin from a great variety of causes, viz.: (*a*) exposure, and attacks of vermin (*morbus Reonum*, Greenhow; *Vaganten Krankheit*, Vogt); (*b*) wasting diseases, as chronic phthisis; (*c*) syphilis; (*d*) malaria; (*e*) liver disease or jaundice if long-continued; &c.; but in none of these cases should there be any difficulty if the preceding dictum is borne in mind.

Prognosis.—This is always unfavourable, but it is impossible to assign any definite period for the termination of the disease, since it often progresses irregularly, with periods of improvement followed by relapse.

Treatment.—From what has just been said it is plain that not much is to be effected by treatment as regards the cure of the disease, but much may be done by careful management to retard its progress and comfort the patient. As soon as the disease is discovered, the sooner the patient makes up his mind to an invalid life the better. Rest and careful dieting are the basis of the treatment. As regards diet, it may be briefly said that what the patient can take best suits best. As the stomach is so irritable, anything likely to upset it should be avoided. Hence, as a rule, it is better to give concentrated nourishment, as essence of meat (*not the extract*) or chicken, or raw pounded meat, when other things cannot be taken. It is also important to bear in mind that the stomach will often tolerate food cold or even frozen, when hot substances would be promptly rejected. In certain stages of this malady it may well be said that the physician's success will depend more on his knowledge of the cookery book than of the Pharmacopœia—not, however, that our pharmaceutical gifts are to be despised. For the profound depression stimulants will be necessary, but these may take the shape of ether or spirits of chloroform, as well as of wine or brandy. For the irritable stomach, alkalies, with nux vomica and ipecacuan, or calumba, are of great service. So, too, in another way, are light tonics and neutral salts of iron; but the stomach should not be clogged with too much medicine. The bowels should not be much disturbed, but, if an aperient be required, a mild one, as a small dose of castor oil, or the compound liquorice powder of the Prussian Pharmacopœia will suit, if the stomach does not rebel; if so, a wineglassful of Hunyadi János water the first thing in the morning, followed by a cup of warm milk, may better agree with the irritable organ; when there is diarrhœa, a totally different line of treatment will be necessary. But in all things, and at all times, the grand rule is to save the patient's strength, to add to it if possible, and to resist the inroads of the disease, whatever shape these may assume.

Alexander Silver.

ADENALGIA (ἀδήν, a gland, and ἄλγος, pain).—Pain in a gland.

ADENITIS.—Inflammation of a gland. *See* the several glands.

ADENOCELE (ἀδήν, a gland, and κήλη, a tumour).—A tumour connected with a gland.

ADENODYNIA (ἀδήν, a gland, and ὀδύνη, pain).—Pain in a gland.

ADENOID (ἀδήν, a gland, and εἶδος, form).—Glandular: resembling the structure of a gland, whether secreting or lymphatic.

ADENOMA (ἀδήν, a gland, and ὁμός, like).—A morbid growth, the structure of which is of glandular nature. *See* Tumours.

ADHERENT. }
ADHESIONS. } —Structures are said to be *adherent* when they become abnormally united together, the morbid formations by which this union is effected being termed *adhesions*. These are most frequently met with in connection with serous surfaces, being usually the result of an inflammatory process, but they may be observed in other structures. The adhesions vary considerably in extent, number, mode of arrangement, firmness, and other characters; they may merely consist of a few loose, slender, and delicate bands, or these bands may be thick and strong, or the contiguous surfaces may be blended and matted together to a greater or less extent, so that they cannot be separated without tearing or cutting them asunder, this last condition constituting *agglutination*. In structure adhesions consist mainly of connective or fibrous tissue, more or less perfectly developed, with a few new vessels.

Effects.—Adhesions are often found at *post-mortem* examinations, which have been of little or no consequence during life, as, for instance, many of those which form in connection with the pleural surfaces. If, however, they are extensive and firm, or if they occupy certain regions of the body, they may prove of serious moment. The principal evils which are liable to result from adhesions may be thus indicated:—1. They often bind parts together, and interfere with the movements of important organs, such as the lungs, heart, stomach, or intestines; in this way preventing the due performance of their functions. 2. When an organ is displaced in any way, as, for example, the heart by pleuritic effusion, it may become fixed in its new position by the formation of adhesions, its functions being thus disturbed. 3. It is highly probable that agglutination may lead to hypertrophy of an organ, *e.g.*, the heart, by embarrassing its movements, and hence affecting its action. 4. On the other hand, atrophy or degeneration of structure may ensue, in consequence of the adhesions interfering with the due supply of blood by pressing upon the vessels, so that the nutrition of the tissues becomes impaired. In the young, also,

the development of structures may be checked. 5. Adhesions may involve important structures, such as nerves or vessels, pressing upon or destroying them, thus giving rise to symptoms of a serious nature. 6. Tubes or canals for the passage of secretions or other materials are sometimes narrowed or obliterated by adhesions. 7. When formed within the abdominal cavity, especially when they take the form of bands, adhesions may prove highly dangerous by compressing, constricting, exerting traction upon, or strangulating some portion of the intestine, in either of these ways leading to intestinal obstruction.

It is frequently difficult or impossible to determine the existence of adhesions by clinical investigation during life; but the history of some past illness during which they were likely to be formed, the results of physical examination, especially in connection with the heart and lungs, and the symptoms present, not uncommonly enable them to be discovered.

FREDERICK T. ROBERTS.

ADIPOCERE (*adeps*, fat, and *cera*, wax).—SYNON.: Fr. *Adipocire*; Ger. *Fettwachs*.

DEFINITION.—A substance formed by a spontaneous change in the dead tissues of animals.

DESCRIPTION.—As seen generally in a dried state in museums, adipocere somewhat resembles spermaceti in consistence, but it is less crystalline in fracture, and is of a dull white or buff colour, the surface being marked by the outlines of blood-vessels or other textures. Adipocere in the earlier stages of its formation, or when formed in a damp situation, is soft, and if rubbed between the fingers communicates a greasy feeling. The odour is peculiar and rather disagreeable.

CHEMICAL COMPOSITION.—Adipocere dissolves in ether, leaving a delicate filamentous web; it burns with a blue flame, yielding a white ash. It is properly described as a soap composed of margaric and oleic acids in combination with ammonia, the fixed alkalies, and alkaline earths; the relative proportion of the latter ingredients varying with the age of the specimen (the ammonia disappearing), and with the composition of the fluids in contact with which the adipocere had been formed. It is said that oleic acid predominates in adipocere formed from dead fish.

MICROSCOPIC APPEARANCES.—When the flesh of animals in which this transformation has recently commenced is examined with the microscope, it is found to be composed of broken-down or disintegrated tissues, fatty granules or particles, together with a few acicular scales or crystals. The granules may be seen in what was muscular tissue to assume somewhat the arrangement of the muscular filaments, thus presenting an appearance resembling an early stage of fatty degeneration. In old and dry specimens of adipocere the crystalline scales form the great portion of the mass, and they may be observed preserving the outlines of the muscular fibres.

ORIGIN.—Adipocere has long been known. It is formed readily from the flesh of animals exposed to moisture, or placed in running water, in very dilute nitric acid, or in alcohol and water in the proportion of 1 to 6. It is often met with in inconvenient abundance in the specimen jars of the anatomist. The bodies of men and other animals buried in peat moss have frequently been found completely converted into adipocere. Lord Bacon mentions it in the *Sylva Sylvarum*, and so also does Sir Thomas Brown in the *Hydriotaphia*; but attention was especially called to its presence when a vast number of bodies were removed (in 1786–87) from the *Cimetière des Innocents* at Paris to the Catacombs. Fourcroy found many of these bodies converted into what he named *adipocire*, a name since retained. Gibbes (as did others) suggested the possibility of applying adipocere formed from the waste flesh of animals to some useful purposes, but the tenacity of the disagreeable odour and the presence of other difficulties have prevented these suggestions from being carried out. With respect to the immediate changes which give origin to adipocere chemists have differed in opinion. One class believes with Gay-Lussac and Berzelius that the compound results from the fat originally present in the tissues, and that the other components are completely destroyed by putrefaction. The other class, which includes the names of Thomas Thomson and Brande, maintains 'that the fatty matter is an actual product of the decay, and not merely an educt or residue.' These opinions may, the present writer thinks, be reconciled by the better knowledge we now possess of the elementary composition of tissues. We know that the combination of fat and albumin constituting one of the earliest steps in the process of nutrition is traceable in the further development and formation of nearly every texture. When that combination is destroyed by a cessation of the process of life, the tissues are as it were resolved into their primary elements. We may thus have adipocere derived not only from free fat, but from the elements of fat existing in and obtained from the decomposition of other tissues. Adipocere may thus be described as both an educt and a product. This opinion is confirmed by the researches of Bauer and Voit, who showed that fatty matter was derived from the metamorphosis of albumin in starved animals, to which phosphorus had been administered.[1]

The interest concerning this substance is not confined to the chemist. The medical jurist has studied it with the view of determining the time and progress of its formation, and of thus ascertaining the probable period at which death occurred. But hitherto no decided or satisfactory information has been obtained, owing to the varied circumstances which influence the progress of the change, in connexion not only with the condition of the body itself, but also with the character of its surroundings. The formation of adipocere has a further and a special interest for the pathologist. It was the study of this process which led the present writer to point out the analogy which exists between it and fatty degeneration in the living body, and thus to establish the pathological doctrine that fatty degeneration is the result of a retrograde metamor

[1] The writer would desire to refer here to the analogy which seems to exist between the change of animal matter into adipocere, and that which occurs in vegetable matter by its conversion into peat and coal. This, however, is not the place in which to examine further such an analogy.

phosis, due to defective nutrition. (*See Medical and Chirurgical Transactions*, vol. xxxiii.)

RICHARD QUAIN, M.D.

ADIPOSIS.—A term which properly signifies either general corpulency, or accumulation of adipose tissue in or upon an organ. *See* FATTY GROWTH; and OBESITY.

ADYNAMIA } (ἀ, priv., and δύναμις,
ADYNAMIC } power).—Terms indicating serious depression of the vital powers, and employed as synonymous with the '*typhoid condition*.' The adjective is applied to diseases in which the phenomena of this condition are prominent. *See* TYPHOID CONDITION.

ÆGOPHONY (αἴξ, a goat, and φωνή, voice).—A peculiar alteration of the resonance of the voice, as heard on auscultation of the chest, compared to the bleating of a goat. *See* PHYSICAL EXAMINATION.

ÆTIOLOGY (αἰτία, cause, and λόγος, word).—That branch of pathological science which deals with the causation of disease. *See* DISEASE, Causes of.

AFFINITY.—This term is the designation of a property by which elementary and compound substances unite with one another and form new compounds. It is, therefore, a property with which chemists are principally concerned. But the ideas suggested to the chemist by the term affinity are also, though less explicitly, excited in the mind of the pathologist and of the therapeutist by certain classes of facts frequently falling under their observation. The pathologist, for instance, knows that saline or earthy matter is very prone to accumulate in the midst of degenerated tissue in the walls of an artery or of a cardiac valve, so as to give rise to a patch of 'calcification'; he knows that in a gouty patient urate of soda is most apt to accumulate and form 'chalk stones' in the tissues around affected joints; he knows that, however it may be administered, arsenic in poisonous doses tends to produce inflammation of the alimentary canal, that strychnia acts with preference upon the nervous system, and that in ordinary cases of lead-poisoning this metal interferes especially with the nutrition of the extensor muscles of the fore-arm. Applications of the same notion in the department of therapeutics are equally familiar in respect to the action of many drugs. It may be regarded as an ascertained fact that iodide of potassium tends especially to influence the nutrition of the fibrous structures in the body, and that bromide of potassium has a no less certain action in modifying the nutrition of the nervous centres in many unhealthy states. Again, there is a whole class of substances which when taken into the system have, whatever their other actions may be, an undoubted effect in modifying the functional activity of the kidney. We have in nitrite of amyl a remedy possessing a remarkable influence over the unstriped muscular fibres of the arteries and bronchi, or else over the nerve-centres by which they are controlled. We have in woorara an agent which acts especially upon the motor side of the nervous system; and we have in digitalis an important remedy which, amidst its other effects, seems to have a decided power of improving the nutrition of the cardiac ganglia. The recent progress of therapeutics encourages us to hope that more and more of these specific effects of drugs will be accurately determined, so that the notion implied by the term *affinity* may, after a time, have a deeper meaning than at present for the practitioner of medicine. *See* ANTAGONISM.

H. CHARLTON BASTIAN.

AFFUSION.—A method of treatment which consists in pouring a fluid, usually water, either cold or warm, upon the patient. *See* WATER, Therapeutics of; and BATHS.

AFRICA, South.—*See* APPENDIX.

AGEUSTIA (ἀ, priv., and γεῦσις, taste).—Loss of taste. *See* TASTE, Disorders of.

AGONY (ἀγών, strife or struggle).—Agony implies bodily pain or mental suffering so intense that it cannot be endured, but excites a struggle against it. It is also applied to the final struggle that often precedes death. *See* DEATH, Modes of.

AGORAPHOBIA (ἀγορά, a market-place, and φόβος, fear). SYNON.: Fr. *La peur des espaces*.—By these names a peculiar nervous complaint has been recognised, characterised by a feeling of alarm and terror, accompanied with a group of nervous symptoms, which some individuals experience when they are in a certain space. The condition may be developed rapidly or gradually, and the chief phenomena observed are as follows:—A sudden sensation is experienced, as if the heart were being grasped, while this organ palpitates violently; the face becomes flushed; the legs feel weak, tremble, and seem as if they would give way under the body. There may be sensations of itching, coldness, or numbness; or profuse sweating may occur. There is no true vertigo; the special senses are unaffected; and consciousness is not at all impaired. A curious impression is sometimes experienced, as if space were elongating itself out indefinitely. Persons who are thus affected are quite sensible of the foolishness of their fear, but cannot be reasoned out of it. During the attacks they feel a strong inclination to cry out, but fear to do so. They think that their dread is known to others, and many of them endeavour to conceal their feelings, lest they should be considered insane.

The circumstances under which the symptoms just described may be experienced are various. They may be felt, for instance, in the street, especially if the shops are shut; in public buildings, such as churches, concert-rooms, or theatres; in omnibuses, cabs, or other conveyances; on a bridge; or in looking at an extended façade or flying perspective. Most persons who suffer thus in the street feel better when with some one, or when near some object, such as a carriage, or even when carrying an umbrella or a stick. Occasionally, however, they shun other people, especially acquaintances.

But little is known as to the origin and nature of agoraphobia. The complaint is not regarded

as idiopathic, but as sequential to some other condition. It occurs in males and females, and the individuals affected may be strong and in good bodily health, while they are often intelligent and well-educated. A history of hereditary nervous disorder can be traced in some cases, indicated by the occurrence of insanity or epilepsy in members of the family; and the patients themselves may present indications of a nervous temperament. Their emotions may be easily excited; and they may be subject to nervous symptoms, such as headache, a feeling of heat in the top of the head, sparks before the eyes, occasional faintness, or motor disorders.

FREDERICK T. ROBERTS.

AGRAPHIA. *See* APHASIA.

AGRIA (ἄγριος, wild).—This term signifies angry and severe. Willan describes a *Lichen agrius*, which is likewise termed *Agria*; it is a circumscribed inflammatory *eczema* situated on the back of the hands. The qualities implied by agria are excessive pruritus, burning pain, thickening, fission, and copious exudation.

ERASMUS WILSON.

AGUE.—A popular synonym for Intermittent Fever. *See* INTERMITTENT FEVER.

AGUE-CAKE.—A form of enlargement of the spleen, resulting from the action of malaria on the system. *See* SPLEEN, Diseases of; and MALARIA.

AIR, Ætiology of. *See* DISEASE, Causes of.

AIR, Therapeutics of.—Air is employed in the treatment of disease in many ways and for many purposes. It is used, first, as *the atmosphere*, a gaseous mixture of definite composition and with a variable pressure. Secondly, advantage is taken of air as a *vehicle* for other substances in the gaseous or finely divided state. And, thirdly, it is selected as a *medium* by which *the temperature* of the body may be readily and effectively influenced. In the first of these relations only—as pure air—will its therapeutics require to be considered in this article. The application to the body generally of air that has been warmed, or warmed and loaded with moisture, will be found described in the article on BATHS; while its administration to the respiratory organs, either in this form or as a vehicle for such substances as creasote, carbolic acid, alkaloids, and sulphurous acid, will be discussed under INHALATIONS.

PRINCIPLES.—The dual relation in which the air stands to the economy—as a definite compound of certain gases, and as an atmosphere with a certain pressure—is very frequently disturbed; and this disturbance accounts for some of the most familiar phenomena of disease. Alteration in the quality or quantity of the respired air, whether from the state of the atmosphere itself or from derangement of the complex apparatus of respiration and circulation, is the cause of some of the most serious and distressing symptoms attending diseases of the chest. It might be predicted by the physiologist that under these circumstances relief would be afforded, at least to symptoms, by suitable alteration of the composition or volume of the air. The method of treatment thus rationally indicated is further readily practicable—the supply of air is unlimited; its composition may be altered at pleasure; its pressure may be increased or diminished; and such alteration will alter its chemical properties. We find accordingly that, ever since the discovery of the composition of the atmosphere, frequent trials have been made of its value therapeutically. Oxygen was early recognised as its active constituent, and came to be administered, as it still is, in the form of inhalation. From time immemorial, indeed, advantage has been taken of the purity and certain other unknown qualities of the air for the prevention and treatment of disease; and the character of the atmosphere is naturally reckoned one of the most important elements of climate (*see* CLIMATE). More recently use has been made of the powerful properties that air possesses when *physically* changed. Within the last few years a remarkable advance has been made, on the one hand, in the physiology of respiration and the relation of the circulation to the atmospheric pressure, and, on the other, in the pathology of diseases of the chest. Clearer views have been reached on the signification of various symptoms, and especially of dyspnœa in its different forms. At the same time observations upon the effects of compressed and rarefied air have been becoming more exact. Pursuing the physiological track, modern therapeutists have availed themselves of this knowledge, and revived the use of air physically altered in the treatment of diseases of the lungs, heart, and other parts of the body. This application they are now able to make with accuracy, and the success of the reformed system of aërotherapeutics appears to be unquestionable. Although in England it is seldom heard of beyond hydropathic establishments, the system is more extensively employed on the Continent. Its leading principles and some of its most important applications will be here briefly described.

The physiological effects of compressed or of rarefied air will manifestly be different according as it is admitted to the body as a whole, or only to a part of it. Familiar examples of the former condition are afforded by descent in the diving-bell, or ascent in the balloon; and of the latter by the action of the cupping-glass, and the effect of interrupted or frequently repeated respirations upon the pulse and system generally. Under the first circumstances the alteration of pressure is absolute; under the second it is relative, and capable of producing most important disturbances in the distribution of the vital fluids. The two methods of application must accordingly be separately discussed.

GENERAL AËROTHERAPEUTICS.—The effects of *compressed air* on the body as a whole have been studied in the *air-bath*, a simple mechanical arrangement in the form of an iron chamber, which can be filled with air at any pressure, whether above or below the normal, by means of steam-power. The principal physiological effects of air condensed by three-sevenths of an atmosphere were ascertained by von Vivenot to be:—Pallor of the skin and mucous membranes; a sensation of pressure in the ears;

diminished frequency of respiration, the act becoming easier; enlargement of the lungs, and increase of the vital capacity; depression of the cardiac force, and diminution of the size and strength of the pulse; rise of temperature; increased vigour of muscular action, secretion, and nutrition generally; compression of the gaseous contents of the intestines; and, perhaps, increased absorption of oxygen and excretion of carbonic acid. When the pressure is excessive, dangerous or even fatal symptoms may supervene. Frequent exposure to condensed air will induce considerable increase of the vital capacity; and most of the other effects, both physical and chemical, will tend to persist. In a word, it may probably be said that the air-bath acts on the system, first, by increasing the general mechanical pressure; and secondly, by admitting an increased amount of oxygen. In employing the air-bath, the patient is kept in it for a period of two hours, at first daily, but after some weeks less frequently. The pressure, which is employed in different cases at one-fifth to one-half of an atmosphere above the normal, must be slowly raised on admission, and reduced on removal of the patient.

The number of *diseases* in which the air-bath may be given with success is limited:—(1.) In certain forms of dyspnœa:—thus it gives great relief in spasmodic asthma, and may also afford temporary relief in emphysema, but its prolonged use appears to be positively bad, as it increases the pulmonary distension. (2.) In hyperæmia and catarrh of the air-passages, including pertussis. (3.) In imperfect expansion or threatened retraction of the chest, as in the subjects of phthisis and chronic pleurisy. Compressed air has also been extolled in some forms of cardiac disease, and in general malnutrition.

The effects of *rarefied air* admitted to the body as a whole do not demand description in this place, either in their physiological or in their therapeutical aspect. Artificially rarefied air is never employed in the form of the bath; and the natural supply in elevated regions, which has found so much favour as a means of treatment in phthisis, is a subject that belongs to CLIMATE and PHTHISIS.

LOCAL AËROTHERAPEUTICS.—When it is desired to bring compressed or rarefied air into contact with the *respiratory* surface only, a different apparatus must be employed. Several forms have been introduced, respecting which it will be sufficient to state that the air contained in a gas-holder is compressed or rarefied by simple mechanical means, and thereafter brought into relation with the air-passages by an arrangement of tubes and valves. There are four possible methods of application:—(1) Inspiration of condensed air; (2) Expiration into condensed air; (3) Inspiration of rarefied air; and (4) Expiration into rarefied air. The physiological effects of the several methods have been carefully investigated by Professor Waldenburg, of Berlin, whose account we shall follow.

Inspiration of condensed air. — Inspiration of air that has been condensed by one-sixtieth to one-fortieth of an atmosphere produces a sensation of extreme distension of the chest, accompanied by an actual expansion of the thorax and lungs, and an increased admission of air, so that inspiratory dyspnœa, if present, is relieved. At the same time the other thoracic contents are compressed, the systemic vessels fill, the arterial pressure rises, and the jugulars become distended. The lungs and heart will be comparatively anæmic. If the application of condensed air be frequently repeated, the vital capacity, the size of the chest, and the respiratory force, may all be increased, and partial relief may be permanently afforded to dyspnœa.

Expiration into condensed air is most difficult of accomplishment, and ends in apnœa in inspiratory time. The effect on the circulation does not differ essentially from that just described.

Inspiration of rarefied air.—Inspiration of air that has been rarefied by one two-hundred-and-fortieth to one one-hundred-and-twentieth—or even, after a time, by one-sixtieth—of an atmosphere, immediately causes the phenomena of inspiratory dyspnœa: the thoracic viscera are congested, and hæmoptysis may result, for the effect may be regarded as that of dry-cupping the pulmonary alveoli. The heart at the same time becomes full, and the jugulars collapse.

Expiration into air that has been *rarefied* by one-sixtieth of an atmosphere is attended with a sense of extreme compression of the thorax: at the same time there is actually a partial retraction of the lungs, an increase in the volume of expired air, and a corresponding diminution in the amount of residual air in the chest. Expiratory dyspnœa, if present, is relieved. While the lungs thus diminish in size, the other thoracic viscera are dilated—the heart and the pulmonary and other vessels within the chest being filled at the expense of those external to it, both arteries and veins. If the expiration into rarefied air be frequently repeated, the circumference of the chest will be diminished, while the vital capacity will be actually increased, along with increase of the inspiratory and expiratory force.

Applications. — The method of *inspiring condensed air* is obviously indicated in diseases where inspiratory dyspnœa is an urgent symptom. Spasmodic asthma, stenosis of the air-passages from anatomical causes, acute and chronic bronchitis, and atelectasis, have all been successfully treated by this method. In croup, where it is urgently indicated, it is most difficult or even impossible to employ. In threatened phthisis it is used prophylactically; and in chronic pleurisy it may prevent or remove the effects of collapse and retraction of the chest wall. The inhalation of condensed air should also be of use in certain forms of cardiac dilatation, especially that due to mitral incompetence. Improving as it does the general nutrition, it may be combined with other remedies for anæmia. In the administration of condensed air, a 'sitting' should last from ten to thirty minutes, once a day—seldom twice. — *Expiration into condensed air* is not used therapeutically. — *Inspiration of rarefied air* may be regarded as a means of exercising the inspiratory muscles. Like the atmosphere of great altitudes, it may therefore be employed in persons with badly developed chests; and even in phthisis it may, by increasing the amount of blood in the lungs, prevent caseation and promote absorption of the

products. In disease of the right side of the heart, it would assist the flow of blood from the veins into the lungs, but it is not likely to be employed for this purpose.—*Expiration into rarefied air* promises to be the most successful and most extensively employed of all the methods. In it, according to Waldenburg, we have the physical antidote for emphysema, and in his hands the majority of such patients have been either cured or radically benefited. It has also afforded great relief in some cases of bronchitis, where it increases expectoration.

Other local applications of the physical properties of the air, as seen in aspiration, cupping, Junod's boot, and inflation, are described elsewhere in this volume. J. Mitchell Bruce.

AIR IN CELLULAR TISSUE. *See* Emphysema, Subcutaneous.

AIR IN VEINS. *See* Veins, Air in.

AIR-PASSAGES, Diseases of. *See* Respiratory Organs, Diseases of; also Larynx, Trachea, and Bronchi, Diseases of.

AIX-LA-CHAPELLE, Waters of. Thermal sulphur waters. *See* Mineral Waters.

AIX-LES-BAINS, Waters of. Hot sulphur waters. *See* Mineral Waters.

AKINESIA. *See* Acinesia.

ALBINISM (*albus*, white).—Definition.—A state of whiteness or absence of colour of the integument and certain other tissues, consequent on defect of pigment-formation. The want of colour may be *complete* or *incomplete*; *partial* or *universal*; *congenital* or *accidental*. Partial albinism may be limited to a spot of small dimensions; or there may be many such spots of variable extent, dispersed over the surface of the body, and giving rise to the appearance which is denominated *pied* or *piebald*; whereas in universal albinism the defect of pigment is not restricted to the integument, but is especially remarkable in the iris and choroid membrane of the eyeball.

General Characters.—Persons and animals affected with albinism are called *albinoes*. It would seem more correct to limit the term albino to those in whom the absence or defect of pigment is universal, and demonstrable not only in the integument but likewise in the eyeball. In the true albino, therefore, the skin is white and pink and more or less transparent, and this both in the fairer and in the darker races of mankind; but in certain of the latter, where the pigmentary function is simply defective and not totally wanting, the colour of the skin may be grey or tawny, and more or less variegated and freckled. The hair, sometimes of a pure silvery or opaque white, may be diversely tinged with yellow or red; occasionally it is flaxen or possesses a greyish hue; and in some instances the whole body is covered with a white down. The iris is grey or pink in accordance with the density of its fibrous structure, and the consequent facility of penetration of the colour of its vascular layer; or, as generally happens in the negro, it is blue. The pupil is contracted and brightly red from the absence of the screen of protection usually afforded to the choroid membrane by its pigmentary layer; and for the same reason the rays of light penetrating the sclerotic and iris give a brilliancy of appearance to the fundus of the eyeball. The absence of pigment in the eyeball is productive of several peculiarities of character in the albino. In the first place the excess of luminous rays penetrating the coats of the eyeball interferes with the correctness of his vision; his retinæ are intolerant of light; he stoops his head, or droops his eyelids, to shelter his eyes; he sees with more comfort in the dimness of evening than in the light of the sun; he is near-sighted; and there is in many cases an oscillation of the eyeballs.

Ætiology.—Albinism is met with among all races of mankind and in every country, but is most common amongst those who are subjected to insalubrious conditions of climate and hygiene. For these reasons it is not uncommon among the natives of the marshy coast of Africa; among negroes who are transferred to unhealthy districts in South America and the West Indies; among the inhabitants of the western coast of South America and Mexico; in certain of the islands of the Indian Ocean; and even in the northern regions of Europe. When albinism is congenital, it has been assumed to be due to an arrest of development; but when accidental, its existence must be referred to exhaustion of chromatogenous or pigment-producing function. Arrest of development has been inferred from the occasional persistence in albinoes of the membrana pupillaris, and of the fœtal down of the skin; from the more frequent occurrence of the condition in females than in males; and from the observation that albinoes are sometimes misshapen and feeble intellectually as well as physically. On the other hand it is well known that albinism is often associated with perfect physical strength and remarkable intellectual vigour. Among other causes to which it has been assigned are heredity, and debility, however induced.

Treatment. — The treatment of congenital albinism must consist in the application of those agencies which tend to strengthen and improve the general health. With regard to the special inconvenience resulting from the absence of pigment in the eyes, it has been observed that the difficulty felt in reading is greatly lessened by using screens or goggles made of some opaque material, such as aluminium, each perforated by a small opening, admitting only the rays of light from the object looked at. The treatment of accidental albinism will be considered under Pigmentary Skin-Disease. Erasmus Wilson.

ALBUMINOID DISEASE. — Syn.: *Waxy*, *Lardaceous*, and *Amyloid Degeneration*. Fr. *Dégénération amyloïde*. Ger. *Speckartige Degeneration* (Rokitansky); *Amyloide Entartung* (Virchow).

Definition.—A peculiar form of degeneration, affecting certain organs, and constituting in its effects a distinct and general disease.

Ætiology—In the majority of cases albuminoid disease is preceded by long-continued suppuration, most frequently in the form of bone- or joint-disease; or else of destructive pulmonary phthisis, empyema, pyelitis, cystitis,

and other affections, where there has been a constant drain of pus. In the absence of obvious suppuration, there is usually present an exhausting disease, as syphilis, ague, or some more obscure cachexia. These antecedent conditions must be regarded as the cause of the malady, and it is only in the rarest instances that no such cause can be traced. It is not easy to recognise the connection, but it may be pointed out that a drain of pus involves not only a loss of highly organised protoplasmic material, but also of potassium salts, which are contained in large proportion in the solid elements of pus, and which salts, as we have seen, are deficient in the affected tissues.

Anatomical Characters.—The organs affected are usually much enlarged, but sometimes they ultimately decrease in size. They are pale, dense, dry, sometimes hard, and either generally or in certain spots translucent. In an advanced stage of the disease the parts appear as if soaked in wax, or other translucent material. If iodine, in alcoholic or aqueous solution, be applied to the affected parts, they are stained yellow, orange, or a deep mahogany brown, according to the degree of the morbid change. If the portions thus coloured be further treated with dilute sulphuric acid, a purplish black colour is produced. These characters depend upon the presence in the tissue-elements of a peculiar substance, allied to the albuminates, and containing, when approximately pure, about 15 per cent. of nitrogen. It is soluble in alkalis, not digested by pepsine, and not readily altered by putrefaction; it gives with iodine the characteristic colour just noted, which gave rise to Virchow's erroneous supposition of its being allied to starch, whence the name—*Amyloid*. This *albuminoid* material being contained in the tissue-elements themselves, and not infiltrated between them, is probably not poured out by the vessels as such, but results from a transformation of the materials of the tissues. Chemical analysis of the affected organs shows a remarkable change in their mineral constituents, the potassium and phosphoric acid being very greatly diminished, as compared with healthy organs; while the sodium and chlorine remain normal, or are proportionately increased.

Albuminoid disease affects most frequently the liver, spleen, and kidneys. Next in order of frequency come the lymphatic glands, and the intestinal mucous membrane, especially its villi; more rarely the suprarenal bodies, the pancreas, the urinary mucous membrane, or the omentum are involved; and, quite exceptionally, other parts, such as the thyroid body, the generative organs, the heart, and the lungs. In most organs the blood-vessels and their appendages, (glomeruli of the kidneys, Malpighian corpuscles of the spleen) are the seat of the morbid change; but in some, such as the kidney, secreting cells may also be affected, and in the liver these structures are chiefly or solely involved. The diseased elements are enlarged, translucent, and structureless.

Symptoms, Diagnosis, and Prognosis.—The *general* symptoms of albuminoid disease are anæmia, debility, a cachectic appearance, and sometimes capillary hæmorrhage. The *local* symptoms are chiefly important in the case of the liver, spleen, and kidneys. Uniform smooth enlargement of the liver and spleen, which can be referred to no other cause, may be due to the albuminoid change. Where the kidney is affected, albuminuria, dropsy, uræmia, and a train of symptoms arise, which, regarded as a whole, differ from those of other kidney diseases. The *diagnosis* is greatly confirmed by (1) the simultaneous occurrence of disease in several organs; (2) a history of suppuration, or of some cachectic disease, especially syphilis. The *prognosis* is extremely unfavourable, and, when the disease is far advanced, it is hopeless.

Treatment.—Though in advanced cases treatment can avail but little, there is reason to think that were the occurrence of disease anticipated, or its presence earlier recognised, prevention, or even cure, might be possible. In all such complaints as chronic joint-disease, psoas abscess, syphilitic disease of bone, or prolonged empyema, the probability of this frequently fatal *sequela* should be borne in mind, and guarded against by a suitable regimen. The diet should not only be generally nutritious, but should include more especially abundance of nitrogenous food (albuminates), as well as the potassium salts, which the affected tissues lack. These are, indeed, largely contained in the juices of fresh meat, and also in the green parts of vegetables. Among drugs, nutrient tonics, of which iron and cod-liver oil are the type, must hold the first place; but the administration of potassium salts, as proposed by Dr. Dickinson, is also indicated. Of these we should be induced, on *à priori* grounds, to select those of which the local action is least violent, and which cause little vascular depression, such as the bicarbonate, or the citrate, or other organic salts. The danger of 'potash poisoning' is very remote.

J. F. Payne.

ALBUMINS.—Definition.—Albumins are substances closely resembling egg-albumin, the chief constituent of white of egg or albumen. To distinguish between the white of egg and its chief constituent, the former is spelt albumen and the latter albumin. Albumins constitute a sub-division of the class of albuminous bodies, which includes all substances having a general resemblance to albumen.

Enumeration.—The sub-class properly contains only two members, *egg-albumin* and *serum-albumin*; but the name *Bence-Jones's albumin* has been given to an albuminous body differing very considerably in its properties from the other two.

Characters.—Egg-albumin and serum-albumin are semi-transparent, yellowish, and structureless when dried. They are soluble in water; and this solution is coagulated by boiling. From the same solution they are precipitated by (*a*) nitric acid; (*b*) salts of the heavy metals, for example, copper-sulphate; (*c*) acetic acid with potassium-ferrocyanide; (*d*) boiling with acetic acid and a neutral salt, for example, potassium-sulphate; (*e*) alcohol. Egg-albumin is distinguished from serum-albumin by the coagulum which it forms with nitric acid being insoluble in excess, while that of serum-albumin is soluble. Bence-Jones's albumin gives no precipitate with excess of nitric acid unless left to stand, or unless heated and left to cool, when it forms a solid

coagulum. This coagulum redissolves on heating, and again forms on cooling. It may be separated from ordinary albumin by adding nitric acid, boiling, and filtering when hot. The ordinary albumin will remain on the filter while Bence-Jones's albumin will pass through, and will coagulate when the filtrate cools.

Modifications.—By the action of acids and alkalis albumin may be converted into *acid-albumin* and *alkali-albumin* respectively, neither of which is coagulated by boiling.

Acid-albumin may be formed in two ways:—First, by dissolving solid albumin in concentrated nitric or other mineral acid with the aid of heat. Secondly, by heating an aqueous solution of albumin with one of these acids very much diluted (1 in 500). Although soluble in very concentrated or very dilute acids, acid-albumin is insoluble in moderately dilute acids. Therefore, when the solution in concentrated nitric acid is diluted with water, a precipitate is formed, which redissolves when much water is added. And, conversely, when acid-albumin is made by boiling a solution of albumin in water with very dilute nitric acid, the addition of more acid will throw down a precipitate, which redissolves if a very large excess of the concentrated acid be added, and especially if it be heated at the same time. On neutralizing a solution of acid-albumin, a precipitate is thrown down, which dissolves in excess of alkali.

Alkali-albumin, or *Alkali-albuminate*, as it is also called, is formed by dissolving albumin in caustic potash or soda; or by adding either of these to its aqueous solution and allowing this to stand, or heating it. This modification is not precipitated by heat, but is precipitated by neutralization; the precipitate dissolving very readily in slight excess of acid. If alkaline phosphates are present in the solution, as they are in urine, alkali-albumin requires a slight excess of acid to throw it down, and is not precipitated by exact neutralization, as acid-albumin would be under similar circumstances. T. Lauder Brunton.

ALBUMINURIA.—Definition.—A condition characterised by the presence of albumin in the urine. Other albuminous bodies, not albumins, may be present in hæmatinuria, hæmaturia, pyuria, and spermatorrhœa.

Symptoms.—Albumin may occur in the urine without any symptoms whatever, but its continuous loss leads to anæmia and changes in the circulation, which usually originate the following symptoms—a pallid pasty complexion, dry skin, and tendency to œdema of the cellular tissue noticeable on the eyelids and shins; derangement of digestion, flatulence, occasional nausea, and irregularity of the bowels; nervous disorder shown by muscular weakness, languor, lassitude, vague pains about the loins, and headache; calls to make water during the night; palpitation, and frequently accentuation of the second sound of the heart over the aortic cartilage, and reduplication of the first sound over the septum ventriculorum.

Tests for Albumin.—The two tests usually employed to detect albumin in the urine are—first, boiling; and, secondly, the addition of nitric acid; both of which produce a cloud or precipitate. If the urine is turbid the albuminous cloud may not be noticed; and therefore such urine should be filtered before the application of either test, unless the turbidity, being dependent on the presence of urates, is removed by heat.

Method of employing the test by boiling.—With the object of saving time the urine is often boiled at once, but the results thus obtained are liable to several fallacies, which will be subsequently described. In order to avoid such fallacies the following method should be pursued:—Ascertain the reaction of the urine; and, if it be alkaline or very strongly acid, add acetic acid in the one case, or liquor potassæ in the other, until its reaction is only slightly acid. Fill a test-tube to about one-third of its capacity with the urine, and hold it obliquely in the flame of a spirit lamp in such a manner as to heat the upper part of the fluid only, until it boils. If it be turbid from urates, it should be first warmed throughout until it becomes clear, and then the upper part only should be boiled. Finally, add a drop or two of acetic or nitric acid.

If albumin be present, it will form a cloud or a coagulum, more or less dense according to its amount. When there is much albumin, its quantity may be roughly estimated by allowing the urine to stand for a definite number of hours, so that the coagulum may subside, and then observing whether it forms a fourth, a third, or a half of the whole length of urine in the test-tube. A small quantity causes a cloud, but no distinct coagulum; and, if merely a trace be present, a faint haze only will be observed, which is best seen by looking through the test-tube at a dark object. The advantage of heating the upper part only of the urine is, that the lower portion, which remains clear, affords a standard by comparison with which a faint cloud in the heated part may be more readily detected.

Fallacies of the test by boiling.—The first fallacy is that albumin may be present, and yet no cloud or coagulum be produced on boiling. This may occur if the urine be alkaline or very strongly acid, because alkali-albumin or acid-albumin, which are soluble in water, may be formed. It is to prevent the formation of *alkali-albumin* that acetic or nitric acid should be added to alkaline urine before boiling. This addition of acid also causes the coagulum to separate more readily; and it should therefore be made when the urine is neutral. On the other hand, urine rarely or never contains sufficient acid to form *acid-albumin*, unless the patient has been taking mineral acids; and therefore the addition of liquor potassæ is not necessary except under these circumstances. The second fallacy of the test by boiling is, that a cloud resembling that of albumin may be produced, although the urine is free from this substance. This occurs when the acidity of the urine is too slight to hold the earthy phosphates in solution, without the aid of the carbonic acid which it usually contains. When such urine is boiled, the carbonic acid is driven off, and the phosphates are precipitated, forming a cloud like that of albumin. The two clouds are readily distinguished by the addition of a drop or two of nitric or acetic acid, when if due to phosphates it will disappear

by solution; but if caused by albumin it will remain. If an excessive quantity of nitric acid be added, an albuminous cloud may also clear up; for albumin coagulated by heat is soluble in strong acid, though only to a slight extent.

Application of the nitric-acid test.—Pour some urine into a test-tube, and then allow about one-fourth of its bulk of strong colourless nitric acid to trickle slowly down the side of the tube, so as to form a layer below the urine without mixing. Or the acid may be put in the test-tube first, and the urine poured on it. Both processes give the same result. If albumin be present, a haze or cloud will form close to the line where the liquids meet.

Fallacies of the nitric-acid test.—1. Albumin may be present and yet escape detection, if the nitric acid is simply poured into the urine and mixed with it, as is sometimes done. For if there be too much or too little acid, acid-albumin is formed and dissolved; whereas, if the liquids form two distinct layers, as in the process already described, the acid gradually mixes with and shades off into the urine, so that, at a greater or less distance from the line where they join, it is certain to be of the proper strength to precipitate the albumin. 2. Albumin may be supposed to be present when it is not, from the formation of a cloud by the precipitation of acid urates or uric acid. This cloud disappears on the application of heat: and another specimen of the urine tested by boiling gives no cloud. To avoid this fallacy, it is common to employ the test by boiling, in addition to that by nitric acid. 3. The third fallacy is not of common occurrence. It is due to the presence of fat or saponified fats in the urine. Urine containing these when simply boiled gives no cloud; but if nitric acid is added to it in the cold, or acetic acid when it is hot, the fatty acids are precipitated and form a cloud resembling albumin. This is distinguished by not being formed if along with dilute acetic acid some ether is added to the urine before boiling; the ether retaining the fatty acids in solution. If the precipitate produced by nitric acid be collected on a filter, and treated with ether, it will be dissolved, while an albuminous precipitate will not. Copaiba, which can be recognised by its smell, sometimes causes an opalescence in the urine, which is increased by nitric acid, but is removed by heat.

Additional tests for albumin.—When urine contains *mucus*, which would render the presence of an albuminous cloud obscure, a solution of ferrocyanide of potassium followed by acetic acid should be added: this will produce a cloud if albumin be present, while it rather clears up a turbidity due to mucus. A solution of pyrophosphate of soda also precipitates albumin. If a drop of albuminous urine be poured into a test-tube containing one or two drachms of a saturated solution of picric acid, a precipitate is formed. These tests are sometimes useful in determining the presence of albumin in the urine in doubtful cases.

Quantitative Estimation of Albumin.—There are three methods in common use for this purpose. The first is easy but inexact. It consists in boiling the urine with dilute acetic acid in a test-tube, allowing the coagulum to subside for a definite number of hours, and then estimating the proportion it bears to the quantity of urine boiled, for example, a fourth, a third, &c. The second is the most exact, but is troublesome. It is like the first; but the urine is carefully measured before boiling, and the amount of coagulum is ascertained by collecting it on a weighed filter, washing, drying, and again weighing it. The third method is easy and tolerably exact. A tube of known length is filled with urine and placed in a polarizing apparatus. From the amount of rotation which the polarized ray undergoes in passing through the urine, the amount of albumin it contains may be calculated. A fourth method has recently been recommended by Dr. W. Roberts. It consists in diluting the urine with water until it gives a haze on the addition of nitric acid, which does not become visible until between one-half and three-quarters of a minute after the acid has been added. This dilute urine contains 0·0034 per cent., or 0·0148 grain of albumin per fluid ounce; and from the degree of dilution required the amount contained in the urine may be calculated.

Pathology.—Albuminuria has been said to occur in consequence of various conditions: *e.g.*, changes in the blood, changes in the circulation, changes in the kidneys. Thus abstinence from salt, or a diet of eggs alone, is said to produce albuminuria by altering the constitution of the blood; and an alteration in this fluid is supposed to be partly the cause of the albuminuria observed in high fevers, scarlatina, diphtheria, and osteo-malacia. The albuminuria of heart-disease depends on changes in the circulation, and that of nephritis on alterations in the kidney. In order to distinguish more clearly between the different kinds of albuminuria we may divide them into—1st, *true* albuminuria, in which serum-albumin appears in the urine; 2ndly, *false* albuminuria, in which some other albuminous body, but not serum-albumin, is present. In *true* albuminuria there is always some change either in the circulation through the kidney, or in the structure of the kidney itself. In *false* albuminuria the albuminous body passes out through the kidney, without there being any alteration either in its circulation or structure.

The chief albuminous bodies occurring in *false* albuminuria are hæmoglobin, egg-albumin, and Bence-Jones's albumin. Hæmoglobin occurs in the urine whenever blood is present in it (*see* Hæmaturia), in which case it is contained in the corpuscles; or it may occur free (*see* Hæmatinuria), the blood-corpuscles, while still circulating in the vessels, having undergone solution. This may result from the inhalation of arseniuretted hydrogen, or from the introduction of bile-acids or of a large quantity of water into the veins. Hæmoglobin is also found in the urine in paroxysmal hæmatinuria, but the cause of the solution of blood-corpuscles in this disease is unknown. Egg-albumin is excreted by the kidneys, and appears in the urine, whenever it is injected directly into the circulation or under the skin, or when it is absorbed unchanged from the stomach or rectum. When taken into the stomach it is usually completely digested before it undergoes absorption; but when taken in such

large quantities that the whole of it cannot be digested, part of it is absorbed unchanged and is excreted in the urine. Thus a diet consisting exclusively of eggs, especially when continued for several days, produces false albuminuria, and large enemata of eggs have a similar effect in animals and probably also in man. Bence-Jones's albumin is of very rare occurrence. It is found in osteo-malacia. Like egg-albumin, it is excreted by the kidneys when it is injected into the circulation or in large quantities into the intestine. It is almost if not quite identical with the hemialbumose, which Kühne finds to be one of the products of imperfect digestion. It seems probable that those cases of albuminuria which appear to depend on imperfect digestion are due to the passage into the systemic circulation of albuminous bodies, which have not undergone the proper transformation in the alimentary canal or liver.

In *true* albuminuria there must be some change, either in the circulation or structure of the kidney, for serum-albumin differs from the other albuminous bodies just mentioned, in not being excreted by the healthy kidney. Some regard the alterations in circulation which produce albuminuria as of two kinds:—(*a*) increased pressure of blood in the renal arteries; (*b*) increased pressure in the renal veins. Increased pressure in the arteries may depend either on general high arterial tension, or upon an increased local supply of blood to the kidney, owing to dilatation of the renal arteries, such as follows division of their vaso-motor nerves. Experiments seem to show, however, that increased tension in the renal arteries does not produce albuminuria, and that the only change in circulation which will cause it is increased pressure in the renal veins. Congestion of the renal veins may be produced by ligature of the renal arteries, and when the flow of blood through the kidney is temporarily arrested by ligature of the artery, the urine secreted after the removal of the ligature is albuminous. Venous congestion of the kidney also occurs whenever the onward flow of venous blood is obstructed, either by a ligature on the renal veins; by the pressure of a tumour or of the pregnant uterus upon them or the vena cava; by disease of the liver obstructing the vena cava; or by disease of the heart or lungs, such as tricuspid or mitral regurgitation, or chronic bronchitis and emphysema. The temporary albuminuria sometimes observed after cold bathing may also be due to venous congestion; and it is probable that albuminuria consequent upon lesions of the nervous system is due rather to the changes which these produce in the circulation than to any direct action of the nerves upon the tissues of the kidney itself. The albuminuria observed after varnishing the skin is probably due to the retention of some substance which acts as a poison. The structural changes in the kidney which cause albuminuria are acute and chronic inflammation, waxy degeneration, and cirrhosis. *See* Bright's Disease.

Treatment.—In *false* albuminuria where hæmoglobin appears in the urine, the treatment indicated is to counteract the solution of blood-corpuscles; and for this purpose quinine is very often useful. When other kinds of albumin appear in the urine, and are probably due to imperfect digestion, the treatment is to give some artificial digestive fluid. Arsenic is also useful. Regarding those cases of osteo-malacia in which Bence-Jones's albumin occurs, we unfortunately know very little.

In *true* albuminuria, depending on venous congestion, the obstacle to free circulation should be removed, if possible; and congestion lessened, both by drawing the blood from the interior to the surface of the body, and by causing contraction of the renal vessels. The blood may be drawn from the interior to the surface by means of warm baths, but in some cases they prove injurious rather than useful, and the employment of a wet pack, which has a similar effect on the distribution of blood without exciting the heart, is to be preferred. Cupping over the kidneys is serviceable: it probably acts by causing reflex contraction of the renal vessels rather than by actually draining blood away from them. The tone of the renal vessels may be increased by the employment of digitalis (*see* Diuretics); and this drug is useful even when no cardiac disease is present, although its good effects are still more marked when the congestion is dependent on disease of the heart. The constant drain of albumin from the body occasions anæmia, which not only produces many unpleasant symptoms, but tends to cause fatty degeneration of various organs, from which there is no reason to believe that the kidneys are exempt. The administration of iron, therefore, is the chief remedy in structural disease of the kidneys, and it is useful by diminishing or removing the symptoms of anæmia and the tendency to fatty degeneration consequent thereon, and also by increasing the tone of the vessels, thus diminishing the loss of albumin.

T. Lauder Brunton.

ALCOHOL. Synon.: *Ethyl-Alcohol; Vinic Alcohol; Spirit of Wine* (C_2H_6O).—Alcohol is the product of a process of fermentation induced by the action of a microscopic fungus, *Yeast*, upon certain kinds of sugar, especially grape sugar, but also upon that derived from starch of any description, and, in the same manner, upon milk sugar. In this process a peculiar metamorphosis takes place, by which alcohol and carbonic acid are produced in considerable amount, together with very minute quantities of succinic acid, glycerine, and other bodies.

Alcohol may also be produced synthetically from its elements, carbon, hydrogen, and oxygen.

As alcohol is very volatile, boiling at 172° Fahr. (78° C.), it may readily be separated by distillation from the water with which it is at first combined. Other means must be resorted to, however, in order to separate the very ultimate particles of this water, as a strong attraction exists between the two liquids.

Alcohol, diluted with about 95 per cent. of water, and subjected to the action of another microscopic fungus, is oxidised into aldehyd and acetic acid.

Physiological Effects.—Applied to the skin, alcohol produces a sensation of coolness, due to its rapid evaporation; but, if the application be continued sufficiently long, *irritation*

is excited. This latter effect ensues immediately if alcohol is brought into contact with a mucous membrane. Its strong attraction for water seems to be the chief cause of this action.

Alcohol is a powerful *antiseptic*, probably from the fact that it is capable, even when diluted, of preventing the development of septic germs, such as vibrios and bacteria, as well as of paralysing the activity of those already formed.

There is scarcely any other therapeutical agent the *internal action* of which varies so much according to the dose given. In *small quantity*, and slightly diluted with water, alcohol promotes the functional activity of the stomach, the heart, and the brain; whilst a like quantity, largely diluted, exerts but a limited influence upon these organs: if, however, the dose of alcohol be often repeated, it is readily assimilated; and, becoming diffused throughout the system, undergoes combustion within the tissues of the body, imparts warmth to them, and yields vital force for the performance of their various functions. Simultaneously with this consumption of alcohol, the body of the consumer is often observed to gain in fat—a circumstance due to simple accumulation, the fat furnished by the food remaining unburned in the tissues, because the more combustible alcohol furnishes the warmth required, leaving no necessity for the adipose hydrocarbon to be used for that purpose. A quantity of 100 cubic centimetres of alcohol *per diem* (about three and a-half fluid ounces)—equivalent to about one litre of Rhine wine of medium strength—is sufficient to supply between one-third and one-quarter the whole amount of warmth requisite for the human body during the twenty-four hours. The warmth so supplied cannot be measured by a thermometer, however, any more than can that furnished by the internal combustion of other hydrocarbons, such as the oils or sugars. The subjective impression of increased warmth usually experienced after taking a dose of any alcoholic liquid is deceptive, and is only due to an irritation of the nerves of the stomach, and to the increased circulation of blood through the cutaneous vessels, particularly those of the head.

Doses somewhat larger, but still sufficiently moderate not to cause intoxication, act, for the most part, in the same way; but, as an additional effect, they produce a distinct decrease of temperature in the blood, lasting half-an-hour or more. As far as the matter has hitherto been explained, this latter effect depends upon a directly depressing influence exerted by alcohol upon the working cells of the body, and upon a temporary paralysis of the vaso-motor nerves. The latter is followed, of course, by dilatation of the superficial vessels, particularly those of the head, in consequence of which a larger surface of blood is exposed, and the loss of heat by irradiation into the air is increased, the temperature of the circulating fluid being thus lowered; whilst, the combustion carried on by the cells being retarded, the generation of heat from this source is diminished. The quantity of carbonic acid eliminated is thus diminished, as is also the amount of urea excreted. After the organism has become inured to the action of alcohol, these effects upon the temperature of the blood are less distinctly, or not at all, marked.

The agreeable excitement at first caused by such doses of alcohol is succeeded by a reaction, characterised by lassitude and drowsiness, the latter condition usually lasting longer than the previous one of exhilaration.

The symptoms of intoxication produced by *large doses* of alcohol are sufficiently well known. When the abnormal condition of excitement in the brain induced by this stimulant has been kept up, almost without intermission, for a length of time; or when it is suddenly withdrawn after the organ has been long subjected to it; the disturbance brought about is so great and persistent as to result in a complete overthrow of the reasoning faculties, and the condition known as *delirium tremens* ensues. At the same time that this pernicious influence is being exerted upon the cells of the brain, fatty accumulations may take place in other organs, particularly in the liver, heart, and connective tissues; the blood-vessels become diseased; and, in many instances, cirrhosis of the liver, kidneys, and meninges makes its appearance, as part of the general disorder of nutrition. The shrinking of connective tissue, characteristic of this last-mentioned complication, seems to depend upon the direct irritation caused by the presence of un-oxidised alcohol.

Under ordinary circumstances, and after the consumption of moderate quantities of alcohol, only slight traces of it are to be detected in the urine, and none whatever in the breath. Pure alcohol imparts no taint to the exhalations of the body; the ethers and fusel oils, on the other hand, do so by reason of their being less readily combustible. It is very likely that alcohol is completely oxidised into carbonic acid and water during the process of assimilation; at least, no other secondary products resulting from its disintegration have as yet been detected.

Therapeutical Applications.—There can be no doubt but that a healthy organism, supplied with sufficient food, is capable of performing all its regular functions without requiring any specially combustible material for the generation of heat and the development of vital force. But the case assumes a different aspect when, in sickness, it transpires that, while the metamorphosis of tissue goes on with its usual activity, or with increased energy, as happens in many diseases, the stomach, refusing to accept or digest ordinary food, fails to supply material to compensate for this waste. Here it is, then, that a material which can be most readily assimilated by the system, and which, by its superior combustibility, spares the sacrifice of animal tissue, is especially called for; and such a material we have in alcohol. Small but oft-repeated doses of alcohol, largely diluted with water, are generally well tolerated by the weakest stomach; and, thus given, the absorption and oxidation of the spirit goes on without difficulty or effort on the part of the patient's system.

According to the experiments of Dr. Frankland and others, the burning of 1·0 gramme of alcohol yields sufficient heat to raise the temperature of seven litres of water 1°C.; and the burning of 1·0 gramme of cod-liver oil suffices for nine litres. Now, in taking three table-

spoonfuls of the oil daily, we yield about the same amount of warmth to the body as is given by four table-spoonfuls of absolute alcohol—the quantity contained in a bottle of light claret or hock. The oil, however, is digested and oxidised by the organs of the body with difficulty, while, for the assimilation of the alcohol, scarcely any exertion of the working cells is required. Thus, it can be demonstrated by calculation, as above-mentioned, that heat-producing material, sufficient to supply nearly one-third the whole amount of warmth required by the body within twenty-four hours, is offered in a quantity of 100 grammes (about three and a-half fluid ounces) of alcohol. In this sense alcohol is a *food*; for we must regard as food not only the building material, but all substances which, by their combustion in its tissues, afford warmth to the animal organism, and, by so doing, contribute towards the production of vital force, and keep up the powers of endurance. Alcohol, therefore, diluted with at least 90 per cent. of water (in any convenient form of beverage), may be given with advantage, in small but oft-repeated doses, in most of the acute and chronic diseases where it is desired to sustain the strength of the patient, but where at the same time the digestive organs, from any cause, refuse to tolerate a more substantial form of nourishment, at least in quantities that would answer the necessities of the case. In such cases it is certainly not sufficient to call alcohol merely a *stimulant*. If alcohol served here only in the quality of a stimulant, its effect would soon pass away, leaving the patient more exhausted than ever; for the human organism is so constituted that it cannot be driven to perform its functions by the application of measures that simply stimulate, without supplying some new force to take the place of that put forth by the organs of the body under the impulse of excitement. To take a familiar illustration, alcohol thus given stimulates no more than does the easily burning coal which we put in small quantities upon a languid fire, to prevent its going entirely out.

Medium doses act powerfully upon the brain and heart, and are therefore serviceable as real stimulants in cases where it is desirable to excite the cerebral and circulatory systems to greater activity. We must not forget, however, that, while exciting this increased activity, such doses do not elevate the temperature of the body; on the contrary, where the effect can be measured, it is found that they depress it a little. By continuing to exhibit such doses, we can sometimes (in erysipelas, puerperal peritonitis, and similar diseases) lower febrile heat by alcohol where even quinine proves ineffectual. The consequences of this decline of fever-heat are an immediate restoration to consciousness, if delirium or stupor has been present; and, in any case, a general improvement in the feelings of the patient. Todd and his school, before the application of the thermometer, called this *the effect of stimulus*, while in reality the improvement is due almost entirely to the withdrawal or diminution of febrile disturbance. As fever patients can tolerate large quantities of alcohol without showing any sign of intoxication, it is allowable, and sometimes even necessary, to rise in the scale of doses beyond the limits ordinarily prescribed.

Of late years alcohol has been given during the night to hectic phthisical patients as a preventive against copious and exhausting attacks of sweating, and with a gratifying amount of success. Such patients certainly tolerate the remedy much better than has hitherto been generally supposed. It need hardly be said that, in cases of cardiac excitement, not resulting from fever, alcohol is at least to be used with caution.

Mode of Administration.—One of the most important, but at the same time most difficult, points for decision is the exact nature and quality of the alcoholic drink to be prescribed or allowed to a patient, who may require alcohol in some form. For *general use*, a pure Claret, Hock, or Mosel wine are the preparations most to be recommended. Cognac, Champagne, old Gin or Whisky, and the heavier Southern wines, may also be used according to circumstances. But whatever drink may be selected, it must at least be free from fusel oil to such an extent that a healthy man, even after imbibing a considerable quantity, will not feel any other effects than those of a pure stimulus; that is to say, an agreeable exhilaration of spirits, neither accompanied by a sense of weight in the head, nor followed by that persistent overfilling of the cerebral vessels and dulness of ideas characteristic of the physiological effects of fusel oil.

The *Fusel Oils* (so-called from their oily qualities) consist chiefly of propyl, butyl, and amyl alcohol, of which the last-named forms the largest proportion. In order to examine any specimen of alcohol with reference to its purity from these objectionable constituents, it is only necessary to rub a few drops between the palms of the hands for half a minute, by which rapid evaporation is caused, and then to smell the moist spot left on either palm. If the alcohol be pure no odour whatever should remain, as ethyl alcohol evaporates very quickly; amyl alcohol, on the contrary, is much less volatile, and, if present in the liquid, will not have evaporated, so that its peculiar and unmistakeable odour will remain to attest its presence as an impurity in the specimen examined.

This test is not applicable to the more complicated liqueurs and wines, as these all contain certain odoriferous organic principles of their own that might disguise the smell of the fusel oil. The inoffensive quality of any given preparation, as a wine or spirit, can only be relied upon when one knows by experience that it *is* pure; and then it should always be obtained, if possible, from the same source, so as to ensure uniform purity.

By far the most pernicious of all the ordinary drinks in use is the spirit obtained from potatoes, as this contains the largest proportion of fusel oil. Even after being redistilled, this liquor is still tainted with the poison to a fearful extent. Of course, wines mixed with such spirit possess the same objectionable qualities; whilst wines made from must to which potato-sugar has been added are likewise tainted, though to a less degree. It can easily be demonstrated by experiments upon animals, that amyl alcohol is the agent to the presence of which the extremely poisonous

action of many drinks upon our nerves and other organs is due. All distilled drinks made from other sources than from grapes contain it to a greater or less extent.

To facilitate the process of estimating the quantity of any particular beverage necessary to be administered in order to produce a given effect, a table is subjoined showing the percentage of absolute alcohol contained in average specimens of the different kinds of wine, beer, &c., in common use.

Absolute Alcohol contained in—

Kumiss (a fermented liquor made from whey) is from 1 to 3 vol. per cent.
German Beer[1] is from 3 to 5 vol. per cent.
Hock or Claret is from 8 to 11 vol. per cent.
Champagne is from 10 to 13 vol. per cent.
Southern Wines (Port, Sherry, Madeira, &c.) is from 14 to 17 vol. per cent.
Brandy and the stronger liqueurs is from 30 to 50 vol. per cent.

For *antipyretic purposes* one will need to give an adult daily not less than the equivalent of fifty cubic centimetres (about two fluid ounces) of absolute alcohol, in divided doses within an hour or two. Taking this as a starting-point, the dose suitable for each individual case can be estimated accordingly.

The great quantity of carbonic acid contained in certain 'sparkling' wines acts upon the temperature of a fever patient much in the same favourable manner as the alcohol itself, and when alcohol is to be taken as a food, it would seem that the impregnation with carbonic acid facilitates its absorption.

All that has been stated thus far with regard to the use of alcohol in sickness applies to children as well as to adults. Of course no reasonable person would accustom healthy children to the use of alcoholic beverages; but, in cases of disease, really good and pure wine or brandy can be advantageously employed, even for infants, either as a *stimulant*, an *antipyretic*, or as *an article of food*, according to circumstances.

For *external use*, alcohol has been superseded by various more modern agents, of which carbolic and salicylic acids may be mentioned as the most important. In this connection the author cannot omit to notice one method of applying alcohol, suggested by Dr. Richardson, namely, the treatment of diphtheria affecting the throat, by means of the inhaler, which projects the alcohol-spray with considerable force upon the infected mucous membrane, causing it to penetrate more deeply than any other caustic would be likely to do. C. Binz (Bonn).

ALCOHOLIC INSANITY. *See* Alcoholism, and Insanity.

ALCOHOLISM.—Definition.—This term is applied to the diverse pathological processes and attendant symptoms caused by the excessive ingestion of alcoholic beverages. These are very different if a large quantity is consumed at once or at short intervals; or if smaller quantities are taken habitually: and hence they are subdivided into those due to (*a*) *acute*, and (*b*) *chronic* alcoholism. To the *acute* forms of alcoholic poisoning belong the acute catarrh of the alimentary mucous membrane, rapid coma, some cases of delirium tremens, and certain special forms of acute insanity; whilst to the *chronic* class are referred the prolonged congestions, the fatty and connective-tissue degenerations of the various organs and tissues, most cases of delirium tremens, nervous affections of slow onset and course, and the cachexiæ, which, in varying combinations, attend a continuously immoderate consumption of alcohol.

Ætiology.—That ordinary vinic or ethyl alcohol, in any and every shape, is a sufficient exciting cause of such *chronic* affections is beyond a doubt; moreover, we find that the more concentrated the form in which it is taken, the more surely and rapidly are they induced, and that, although some beverages give a greater liability to certain forms of disease than to others, yet the ultimate tissue-changes produced by all are practically similar, and of a markedly degenerative character, The purest alcoholic fluids will also induce the *acute* forms; but some of the phenomena observed in the worst cases of alcoholic poisoning have been referred, with some probability, to admixture with fusel oil, essential oil of wormwood, cocculus indicus, and other substances, more deleterious even than ordinary alcohol itself. *See* Alcohol, and Absinthism.

The *predisposing causes* of a sudden debauch, such as festive gatherings, example of companions, desire of relief from anxiety and melancholy, &c., scarcely require mention. Acute alcoholic coma is generally due to the rapid consumption of a large quantity, but occasionally it is caused by taking a smaller quantity in the presence of some special condition, such as starvation, prolonged exposure to cold, or debilitating disease.

Chronic habitual drinking is undoubtedly *hereditary* in many cases; not that the ancestors have necessarily been drunkards, but that the family is of unstable nervous organisation, and that the neurotic taint which shows itself in other members in such affections as epilepsy, hysteria, insanity, is manifested in these cases by an intense craving for alcohol. Sometimes a pernicious education, by fostering habits of indulgence in early youth, has led to subsequent excess; and the prescribing of stimulants has occasionally been productive of similar harm. In the experience of the writer, the exhibition of large doses in fevers and acute affections has never done this—indeed, in several instances, a great dislike to stimulants has been produced—but the custom of recommending small quantities to young people and women as a remedy in hysteria, hypochondriasis, neuralgia, and allied disorders, or to relieve the fatigues incident to their daily life, cannot be too strongly protested against. The effect of *occupation* is very marked. Brewers, publicans, potmen, and others who trade in alcohol are, as a class, very intemperate, and so frequently are commercial travellers (Thackrah). Sedentary employments, being more monotonous, are more baneful than out-door occupations. Mechanics

[1] English beer will contain a little more, but the writer has made no personal examination as to exactly how much.

drink more freely than agricultural labourers; whilst night-labourers, cabmen, sailors when on shore, brewers' draymen, navvies, pitmen, and puddlers consume an enormous amount of alcoholic fluids. *Social influences*, such as domestic unhappiness, rate of wages, unhealthy dwellings, bad drinking water, or an intermittent supply, are important factors in the causation of drunkenness. Under some circumstances, alcoholic excesses do less injury than usual, for example, in persons whose employment leads to copious sweating, or necessitates abundant exercise in a keen air; and some constitutions resist their baneful influence to a remarkable extent.

Pathology.—A large amount of ardent spirits acts on the nerve-centres as a narcotic poison, and causes rapid death by coma. Smaller quantities produce intoxication, accompanied with or followed by an acute congestion and catarrh of the alimentary canal, especially of the stomach and duodenum. Habitual dram-drinking, by altering the chemical composition of the blood, and checking the normal changes of its corpuscles, exerts an injurious influence on the nutrition of the tissues. This is increased by the lessened consumption of food, and by the alterations in the calibre of the blood-vessels, set up at first by a special action on their vaso-motor nerves, and afterwards maintained by degeneration of their coats, as well as frequently of the heart itself. Moreover, alcohol probably interferes *directly* with the nutrition of the cell-elements of the various organs as it circulates through them; and it retards the elimination of effete materials—carbonic acid, uric acid, and urea.

Anatomical Characters.—(*a*) *Acute Alcoholism.*—Dr. Beaumont thus describes the appearances which he observed in the stomach of Alexis St. Martin, after an excess of alcoholic stimulants:—'Inner membrane morbid; considerable erythema, and some aphthous patches on the exposed surface; secretions vitiated.' On another occasion, 'Small drops of grumous blood exuded from the surface, the mucous covering was thicker than common, and the gastric juices were mixed with a large proportion of thick ropy mucus and muco-purulent matter slightly tinged with blood.' The *post-mortem* appearances in a case of rapid coma in a patient at King's College Hospital, after taking three pints of raw whiskey, were:—intense injection of the vessels of the pyloric end of the stomach and duodenum, with a peculiar blanching of the mucous membrane between them, giving rise to a vivid scarlet arborescent appearance on a white ground; two ounces of bloody serum in the pericardial sac, and about sixteen ounces in the right pleural cavity (the left being obliterated by old adhesions); double pneumonia of the lower lobes; extreme congestion of the kidneys; and engorgement of the large veins over the posterior part of the brain. Contrary to the usual statements, no alcoholic odour could be detected in the brain, and there was no increase of fluid in the ventricles. The heart, liver, and kidneys were fatty; but these changes were probably of older date. In similar cases Deverjie has noticed a bright red colouring of the pulmonary tissue; whilst Tardieu found pulmonary apoplexies in two cases, and meningeal hæmorrhages in five others. Death from *acute* delirium tremens leaves no marked characters; meningitis and coarse brain-lesions are extremely rare, whilst pneumonia is much more common. After repeated attacks, as well as in old drunkards, fatty degeneration of the viscera, and various other chronic changes are found.

(*b*) *Chronic Alcoholism.*—The amount of fat in the blood is increased, or it becomes more visible. Chronic congestion and catarrh of the stomach, leading to atrophy of the gland-cells and an increase in the submucous connective-tissue, is very constant, but chronic ulcer is not frequent. The liver is at first enlarged from congestion, and may continue so from a subsequent infiltration with fat; but more frequently it shrinks owing to cirrhosis. Lobar emphysema, chronic bronchitis, and hypostatic pneumonia are common. The heart is flabby, dilated, and presents fatty infiltration or even degeneration of its muscular tissue; but it may be hypertrophied, probably as a result of coexistent disease of the kidneys. The arteries and endocardium are studded with atheromatous deposits; the capillaries are congested; and the veins varicose. The kidneys exhibit the fatty, or, more commonly, the granular form of Bright's disease. The muscles are pale and flabby, and even in the bones formation of fat takes place at the expense of the bony texture. The nervous centres are atrophied and tough; the convolutions are shrunken; the nerve-cells and nerve-fibres are wasted; and an increased amount of serous fluid exists in the ventricles and subarachnoid space. The abnormal adhesion of the dura mater to the cranium, the large Pacchionian bodies, the opaque arachnoid, and the thickened pia mater, all testify to an exaggerated development of fibrous tissue. Occasionally hæmorrhage into, or softening of, the brain, consequent on the diseased state of its blood-vessels, is met with. The increase of connective-tissue is especially marked in *spirit-drinkers*, and explains the emaciated appearance, prematurely aged look, sunken cheeks, and wrinkled countenance which they generally present. The *beer-* and *wine-drinkers*, on the contrary, are loaded with fat, not only in the viscera, but in the subcutaneous tissue and the omenta; and hence these subjects are corpulent, with oily skins and prominent abdomens, even when the face and extremities are wasted. Gouty deposits are also frequent. These differences, however, are not nearly so absolute as is maintained by many writers. The presence of a variable amount of dropsy, a congested pharynx, chronically-inflamed conjunctivæ, turgid capillaries, and occasionally papules of acne rosacea on the face, complete the morbid anatomy of the confirmed toper. The antopsy in *alcoholic insanity* discloses no specific characters.

Symptoms.—1. *Acute Intoxication.*—In this state the successive and varying mental phenomena, the disorders of common and special sense, and of the motor apparatus, are well known. These are followed by uneasy sensations and tenderness in the epigastrium, vomiting or retching, headache and vertigo, with dimness and occasionally yellowness of vision on stooping

and rising again. The tongue is furred, the appetite is lost, and there is a constant feeling of thirst. The urine is copious and pale, but afterwards becomes scanty and loaded with lithates. The countenance is sallow, and the general lassitude and depression are very marked.

2. *Acute Alcoholic Coma.*—In slight cases of this condition prolonged drowsiness is the chief symptom: but in the more severe forms the patient is quite insensible; the power of motion is in complete abeyance; the breathing is stertorous; the face is usually pale, the features remaining symmetrical; the pupils are generally dilated, though they may be contracted or even unequal; the pulse is slow and laboured; the skin feels cold and clammy; and the temperature is low—in one case it fell to 92° Fahr. There may be albuminuria; and occasionally the urine and fæces are passed involuntarily.

3. *Chronic Alcoholism.*—The earliest symptoms of this form are muscular tremors, especially on waking; disturbed sleep; noises in the ears; dull headache; occasional vertigo; and disorders of vision. If there be also a foul breath, slightly-jaundiced conjunctivæ, watery eyes, and flabby features, with or without papules of acne rosacea around the nose and mouth, the combination is very characteristic. Irritative dyspeptic symptoms—the *vomitus matutinus* of Hufeland—and the signs of commencing or actual cirrhosis, of Bright's disease, or of fatty heart, frequently coexist. As the affection advances, the insomnia and tremors increase; the mental condition becomes impaired; a striking deficiency of will and uncertainty of purpose are noticeable; the gait becomes ataxic; and the patient has a constant feeling of dread and anxiety.

4. *Delirium Tremens.*—This form of alcoholism occasionally supervenes on a single debauch, but it much more frequently affects the chronic drinker. It generally comes on during a drinking-bout, but this may have terminated before the attack commences. In some cases it is undoubtedly determined by prolonged abstinence from food, mental distress, surgical injury, or the onset of an acute disease, along with the ingestion of alcohol; but in others no cause but the last can be traced. The first stage is indicated by inability to take food; marked anxiety and restlessness; tremor of the voluntary muscles; furred and tremulous tongue; cool skin, which is frequently bathed in perspiration; cold hands and feet; and a soft weak pulse. There is complete insomnia, or short periods of sleep are interrupted by terrifying dreams, and the patient's nights are tormented with visions of horrid insects, reptiles, and other objects pursuing him and eluding his attempts to escape from them or to seize them. Illusions of hearing are not uncommonly added; but the sense of smell is much more rarely involved. If there is no improvement, these not only haunt his nights, but persist in the day-time; he becomes more incoherent, his mental alienation increases, and attempts at suicide are common. The pupils are now minutely contracted, but there is no intolerance of light. The pulse quickens, and is very feeble or even dicrotic; and the general symptoms become more marked. A prolonged sleep may occur in this stage, and the disease thus terminate. If it continues, the strength fails: the pulse becomes small, weak, and thready; the tremor increases; the tongue gets dry and brown in the centre; persistent coma-vigil and subsultus tendinum come on; the patient talks incessantly, and picks at the bedclothes; and death is ushered in by a delusive calm, or takes place in a paroxysm of violence. The writer has known cases in which the attack of delirium tremens always began by several severe epileptic fits.

5. *Alcoholic Insanity.*—The forms of insanity caused by alcoholism are *acute mania* and *melancholia, chronic dementia*, and *oinomania*. In the first homicidal impulses, and in the second strong suicidal tendencies, *due to actual delusions and not to mere passive terrors*, are added to the other signs of delirium tremens. Oinomania is a peculiar form of insanity, in which the patient breaks out into paroxysms of alcoholic excess, attended with violent, strange, or even indecent acts, due to apparently uncontrollable impulses. The attack lasts a few days, and is succeeded by a long interval of sobriety and chastity. These patients have generally some hereditary taint; and not unfrequently evidences, though often slight, of a morbid mental state may be detected in the intervals, if very carefully looked for. *See* Insanity.

Complications.—Most of these have been pointed out, but chronic drinkers are especially liable to pneumonia of a low type, and to rapid phthisis. Delirium tremens is *very rarely* complicated with meningitis; acute alcoholic gastric catarrh may be followed by jaundice; and cerebral hæmorrhage may come on in a drunken fit. Temporary albuminuria is occasionally caused by the ingestion of large quantities of spirits, and even of beer.

Diagnosis.—The diagnosis of *acute* alcoholic gastric catarrh, of insanity from alcohol, and of oinomania depends on obtaining a true history. Acute alcoholic coma can only be diagnosed with certainty by emptying the stomach and examining its contents. Mere odour of the breath is quite fallacious; and the writer attaches but little importance to the state of the pupils, or to the general features of the coma. Convulsions sometimes usher in the condition; and apoplexy may arise from the accidental rupture of a blood-vessel whilst a person is drunk. Opium-poisoning can only be satisfactorily eliminated by examining the contents of the stomach. Uræmic poisoning may be diagnosed by testing the urine, though here an element of uncertainty is introduced by the occasional occurrence of albuminuria in alcoholic cases; the presence of hypertrophy of the heart, of dropsy, of casts in the urine, or other changes typical of Bright's disease, must decide the question. Delirium tremens is occasionally separated with difficulty from some forms of insanity not caused by drink; but in these cases *delusions*, not mere terrors or hallucinations, are of primary importance. The delirium of acute fevers and pneumonia may be mistaken for delirium tremens; but the pyrexia, history of the case, and physical condition of the patient will guide to a correct diagnosis if the possibility of error

is remembered. *Chronic* alcoholism has been mistaken for other chronic nervous affections, such as locomotor ataxy, chronic softening and multiple sclerosis of the nerve-centres, paralysis agitans, chronic tremors from metallic poisons, senile dementia, and commencing general paralysis. In all these maladies, *special* symptoms are present, besides those common to them and to chronic alcoholism.

Prognosis.—In the acute forms of alcoholism the prognosis is favourable so far as the immediate attack is in question. In acute coma, the patient generally, but by no means invariably, rallies from the state of insensibility; but he may die from the supervention of a very rapid pneumonia. The prognosis in delirium tremens is favourable in young subjects; but its gravity increases with every attack, and with the coexistence of disease of the viscera, especially of the heart, liver, or kidneys. Patients with marked symptoms of fatty heart, or in whom pneumonia sets in, but rarely recover. Chronic alcoholism may be temporarily arrested; but the ultimate issue is unfortunately as a rule only too certain, for the habit is in most cases too strong to be broken off, or even to be checked for any lengthened period. Mental impairment, persistent tremors, ataxy, and signs of coarse brain-lesions, are especially significant of a speedy termination.

Treatment.—The *acute gastric catarrh* is most rapidly subdued by washing out the stomach with copious draughts of tepid water, and then giving a saline purge. All forms of alcohol should be rigidly abstained from; and the diet must be simple, and taken in a fluid form for a day or two. Passive exercise in the open air, or, if the patient be vigorous, a brisk ride on horseback, is very beneficial.

In cases of *acute coma* the stomach should be at once emptied by means of the stomach-pump. Cold affusion, followed by energetic friction and the application of bottles filled with warm water, so as to keep up the temperature, will generally revive the patient. Galvanism, in the form of the interrupted current, may often be employed with advantage. If the patient be strong, a smart purge, or, if weak, a milder one, will be all the after-treatment that is necessary.

Delirium tremens must be treated differently in the young and in the old. *In first attacks in young subjects*, complete abstention from alcohol, light and easily assimilated food (milk diet), moderate purgation, and occasionally antimony in doses of one-eighth of a grain, carefully watched, have been most efficacious in the writer's hands. If the patient has two or three restless nights in succession, bromide of potassium (thirty grains), or chloral hydrate (twenty grains), may be given at intervals of four hours, until sleep is procured; but as the disease is spontaneously curable, sedatives must not be pushed. An experienced attendant should be always present, but no form of mechanical restraint is permissible. In *older cases*, a mild purge should begin the treatment; and light but *very nourishing* food should be administered at short intervals. Milk, beef-tea, raw eggs beaten up with milk, strong soups, and such articles are to be given freely; when, by careful management and good nursing, a very severe attack may be tided over, and natural sleep will return in from three to five days. The early administration of sedatives is to be deprecated, but should the restlessness persist, in spite of careful and assiduous feeding, a full dose of laudanum (♏ xxx.—xl.) at bed-time is of great value. In the absence of albuminuria, lung-complications, or any sign of failure of the heart's action, the writer prefers this drug to other sedatives. If the opium alone fail, its combination with an alcoholic stimulant (brandy, whisky, or *stout*) often succeeds. If there be any tendency to syncope, or if pneumonia should come on, as well as in cases complicated with shock, as in surgical injuries, a free use of stimulants is imperative. Hypodermic injections of morphia, and large doses of digitalis, are recommended by many authorities; but the writer has seen great harm attend their free exhibition. The *cautious* inhalation of chloroform vapour has occasionally cut short an attack by inducing sleep, but it much more frequently fails. Mechanical restraint is seldom, if ever, necessary, if the patient be properly nursed and attended to. All methods of self-destruction must be carefully guarded against; and a padded room, when available, is of the utmost benefit.

The great desideratum in *chronic alcoholism* is to substitute an easily-digested and nourishing diet for the alcoholic stimulants, which can then be safely dispensed with altogether. The practitioner's judgment, and his knowledge of the *cuisine*, are very important in the management of these cases. Strong meat-soups and good specimens of the concentrated preparations of meat are of great value. The strictly medicinal treatment will consist in the administration of bitter tonics, such as nux vomica, quinine in small doses, calumba, or gentian; with carminatives, such as spirit of chloroform, armoracia, and capsicum. Alkalis, effervescent mixtures, and hydrocyanic acid are peculiarly useful if the stomach is irritable. The condition of the liver and bowels should be carefully regulated. Bromide of potassium is in general the best sedative to employ against the insomnia, though chloral hydrate is more certain; but the latter should only be given occasionally, lest the patient fall into the habit of frequently resorting to it. In long-standing cases, cod-liver oil, arsenic in small doses, and oxide of zinc have all done good, but they require a long and protracted administration. Phosphorus has been of no use whatever in the cases in which the writer has tried it; but small doses of the more easily assimilable preparations of iron are occasionally well borne, and are then most useful. The craving for drink, if urgent, may be checked by small doses of opium, but this drug must be exhibited with extreme caution. Judicious supervision, and, in inveterate cases, a residence in a proper asylum, are the only means from which any permanent benefit can be expected. The treatment of insanity induced by alcoholism will not differ from that recommended in other forms, except in an enforced abstinence from its cause.

John Curnow.

ALEPPO EVIL. *See* Delhi Boil.

ALGID (*algidus*, cold).—A word implying extreme coldness of the body, used only when it arises in connection with an internal morbid state, such as cholera, or a special form of malignant remittent fever.

ALGIERS.—Warm winter climate. Mean winter temperature 59° F., liable to rapid changes. Heavy rains not infrequent. *See* CLIMATE.

ALIMENT.—Food or aliment furnishes the elements required for the growth and maintenance of the organism; and, through its action with the other life factor—air, forms the source of the power manifested.

The aliment of organisms belonging to the vegetable class is derived from the inorganic kingdom. Under the influence of the sun's rays the inorganic principles are applied to growth, and constructed into organic compounds. This constitutes the main operation of vegetable life, and in it we have the source of the aliment of animals, which can only appropriate organic compounds, and which either directly or indirectly derive these compounds from the vegetable kingdom. As the solar force employed in the construction of organic compounds, through the agency of the vegetable organism, becomes locked up in the compound formed, such compound represents matter combined with a definite amount of latent force. In the employment, therefore, of organic matter as aliment by animals, we have to look upon it not only as yielding the material required for the construction and maintenance of the body, but as containing and supplying the force which is evolved under various forms by the operations of animal life.

Aliment constituting the source from which the several elements belonging to the body are derived, it follows that to satisfy the requirements of life it must contain all the elements that are encountered. It is not, however, with the elements in a separate state that we have to deal, but with the products of nature in which they are variously combined.

The *alimentary products* as supplied by nature are resolvable by analysis into a variety of definite chemical compounds. These constitute the *alimentary principles*. Some are common to both animal and vegetable food, as for instance albumen, caseine, fats, &c.; others are peculiar to either the animal or vegetable kingdom. Starch, for example, is met with only in vegetable, and gelatine only in animal products.

With reference to the alimentary principles, it must be understood that in no case do they exist in natural products in an isolated form, and no single alimentary principle is capable of supporting life. Although, however, it is with the alimentary products as a whole that we are practically concerned, yet, regarded from a scientific point of view, a knowledge of these constituent principles is required, to enable us to assign to them their proper value as alimentary articles; and for the purpose of systematic consideration some kind of classification is needed.

CLASSIFICATION.—Prout classified the constituent principles of food into four groups, which he named (1) the *aqueous*; (2) the *saccharine*; (3) the *oleaginous*; and (4) the *albuminous*. This classification is defective, inasmuch as it omits from consideration saline matter which is equally as essential to nutrition as any other part of an alimentary product. The saccharine and oleaginous groups also stand as primary and independent divisions, whilst physiologically they are related, and may be conveniently considered under a combined heading.

Liebig proposed a classification based on physiological principles; and, taking into account only the organic constituents of food, grouped them under the heads of (1) *plastic elements of nutrition*; and (2) *elements of respiration*. His *plastic elements of nutrition* comprise the nitrogenous principles; and to these he assigned the office of administering not only to the growth and renovation of the tissues, but also to the production of muscular and nervous power. Believing that the source of these powers issued from the oxidation of the respective tissues, he held that the exercise of muscular and nervous action created a corresponding demand for nitrogenous alimentary matter, which thus became invested with an importance that led it to be regarded as affording a measure of the value of an alimentary article. By recent experimental research this view has been found to be untenable. The nervo-muscular organs are now looked upon as holding the position of instruments, by whose agency the force liberated by chemical action is made to manifest itself under certain other forms; and what is wanted for the purpose is simply oxidisable organic material, which may be derived from non-nitrogenous as well as nitrogenous food. The *elements of respiration* or, as they were afterwards more appropriately styled, the *calorifacient principles*, represent the organic non-nitrogenous constituents of food. Their destination, according to Liebig, was heat-production. It is now maintained, however, as stated above, that they play a part in connection with nervo-muscular action; and it may be also said that they are to some extent concerned in tissue-development. From the considerations set forth, Liebig's classification loses the scientific value it was at one time supposed to possess.

The following grouping of the alimentary principles based on chemistry furnishes a classification which involves no theoretical proposition, and is practically convenient:—

Food is primarily divisible into *Inorganic* and *Organic* principles.

The *Inorganic* principles consist of water, and the various saline matters required by the system. They are as much needed for the support of life as the organic portion of food.

The *Organic* principles are sub-divisible into *Nitrogenous* and *Non-nitrogenous*; and the *Non-nitrogenous* are again further sub-divisible into *Hydro-carbons* and *Carbo-hydrates*.

The *Nitrogenous* principles contribute to the growth and nutrition of the various bodily textures, and furnish the active agents of the secretions. They also undergo resolution in the system into urea, which is excreted; and a complementary hydro-carbonaceous portion, which is susceptible of application to force-production. They are thus capable of administering to all the purposes fulfilled by the organic portion of an aliment.

The *Hydro-carbons* or *Fats* are applied to the

production of heat and other forms of force. They seem also to be essential to tissue-development generally, besides yielding the basis of the adipose tissue.

The *Carbo-hydrates* (starch, sugar, gum, &c.) contribute to the formation of fat, and are also applied indirectly if not directly to force-production.

There are a few principles, such as alcohol, the vegetable acids, and pectin or vegetable jelly, which do not strictly fall within either of the preceding groups. Alcohol occupies a chemical position intermediate between the fats and carbo-hydrates; whilst the others mentioned are more highly oxidised compounds than the carbo-hydrates.

All alimentary products in the form supplied by nature contain organic and inorganic principles, and the organic principles comprise more or less of the nitrogenous and non-nitrogenous kinds; but the non-nitrogenous do not necessarily, and indeed do not generally, include both hydro-carbons and carbo-hydrates. In milk, however, which may be regarded, from the position it holds in nature, as furnishing a typical representation of an alimentary article, principles exist belonging to each of the groups enumerated in the above classification. *See* DIET.

F. W. PAVY.

ALIMENTARY CANAL, Diseases of. *See* DIGESTIVE ORGANS, Diseases of; and the several organs.

ALKALINITY.—The reaction of human blood is always alkaline; and, though the normal degree of alkalescence has not yet been determined, it is probable that, like the temperature of the body, it is tolerably constant. In disease considerable variation, no doubt, occurs, but still the blood is always found alkaline. Pettenkofer and Voit found the serum of blood acid in a case of leukæmia some few hours after death, but not during life; and Dr. Garrod states that in chronic gout the serum may become somewhat neutralized, but never acid. F. Hoffman has also found that the blood retains its alkalinity with great obstinacy; he fed pigeons for a considerable length of time on food yielding only acid ash, but the animals suffered from blood-poisoning before the alkalinity of the serum was neutralized. The alkalinity of the blood is maintained by the constant passage into it of the alkaline salts of the food, and of alkaline carbonates derived from the oxidation of the lactic, oxalic, and uric acids furnished by the disintegration of the tissues. The blood is probably prevented from becoming too alkaline by the withdrawal of its alkaline salts by the alkaline secretions, namely, the saliva, the bile, and the pancreatic fluid; whilst the acid salts, which, if accumulated, would tend to depress its normal alkalinity, are removed by the acid secretions, namely, the sweat, the gastric juice, and the urine, and by the exhalation of carbonic acid from the lungs. It has been shown that the withdrawal of acid by one secretion has a decided effect on the reaction of other secretions; thus the saliva becomes more alkaline during digestion, when the stomach is pouring out the acid gastric juice; and Dr. Bence Jones has shown that during digestion the acidity of the urine is lessened. A similar relationship is also shown to exist between the elimination of carbonic acid by the lungs and the acidity of the urine, the latter falling as the former is increased, and *vice versâ*. The importance of a proper degree of alkalescence for the blood is obvious, when we consider that this condition increases the absorption-power of its serum for gases, and is necessary to maintain its albumin in the liquid state, whilst oxidation is always more perfectly performed in alkaline solutions.

ALKALIS.—DEFINITION.—Inorganic substances, which turn syrup of violets green, and turmeric brown; and restore the blue colour to litmus which has been reddened by acids. They combine with acids to form salts, and their carbonates are soluble in water.

ENUMERATION.—The only substances which correspond with the above definition are—Potash, Soda, Lithia, and Ammonia. The alkaline earths—Lime, Magnesia, Baryta, and Strontia, and the organic alkaloids, have a similar action on vegetable blues and yellows; but the carbonates of the former group are almost insoluble in water; whilst the latter contain carbon, and are therefore classed with organic substances.

PROPERTIES.—Ammonia is distinguished from the other alkalis by its volatility. The non-volatile alkalis are readily recognised by their spectra; and by the colour they impart to the blowpipe flame, potash giving it a violet, soda a yellow, and lithia a carmine colour. Potash and soda are present as constituents of the body in considerable quantities; ammonia exists to a smaller amount; and lithia probably in traces. Soda is found chiefly in the blood, potash in the muscles.

ACTION.—When applied to the skin dilute alkalis and their carbonates act as rubefacients. Pure ammonia is a vesicant, and potash and soda have a caustic action. Both caustic potash and soda absorb water from the tissues, and form a corrosive fluid, which destroys the parts around, as well as that to which the caustic has actually been applied. To prevent this effect they are sometimes mixed with lime, which absorbs the water. A mixture of potash and lime forms the Vienna Paste. When inhaled, ammonia causes irritation of the respiratory passages, and increased secretion of mucus. This irritation excites reflex contraction of the blood-vessels and consequent rise of blood-pressure. When swallowed in quantity, the caustic alkalis and their carbonates produce symptoms of irritant poisoning. In the case of ammonia these symptoms may be accompanied by those of inflammation of the air-passages, caused by the irritant vapour. The best antidote is dilute acid, such as vinegar. In small quantities and diluted, alkalis increase the secretion of gastric juice. After absorption into the blood they render this fluid more alkaline; whilst potash appears especially to accelerate tissue-change, and is accordingly classed among the alteratives. When injected directly into the blood, potash acts specially on the muscles, which it paralyses. Ammonia stimulates the motor centres in the brain and spinal cord, the

respiratory centre in the medulla oblongata, and the accelerating nerves of the heart. When injected into the veins it therefore causes convulsions like those of strychnia, and quickening of the respiration and pulse. Alkalis are chiefly excreted by the urine; and potash, soda, and lithia lessen its acidity, or render it alkaline. Ammonia is partly excreted unchanged, but a portion passes out in the form of urea; and it does not render the urine alkaline like the others. Potash and lithia act as diuretics; soda to a less extent; and ammonia least of all. The diuretic action does not depend on any change in the blood-pressure. Potash and ammonia are diaphoretic. Potash lessens the tenacity of mucus.

Uses.—Dilute solutions of potash and soda relieve itching in skin diseases. Caustic potash or soda is used to destroy warts; to cauterize poisoned wounds and ulcers; to open hydatid cysts in the liver; and to establish issues. Ammonia neutralizes the formic acid which renders venomous the stings of bees, ants, and mosquitos, and is therefore applied to relieve the pain which they cause. The intravenous injection of ammonia has been recommended as an antidote in snake-poisoning; but the value of the remedy is not established. Mixed with oil, so as to form a liniment, ammonia is used as a rubefacient in sore throats, bronchitis, rheumatic pains, and neuralgia. It is inhaled to relieve headache; as a restorative in syncope and shock, when it raises the blood-pressure; and to facilitate expectoration in chronic bronchitis. Alkalis administered after meals act as antacids, and relieve heartburn. When given before meals they increase the secretion of gastric juice, quicken digestion, and relieve weight at the epigastrium, pain between the shoulders, and flatulence. Bicarbonate of soda is usually given for this purpose, but when the stomach is very irritable liquor potassæ is preferred, as it is considered to have a sedative action on the mucous membrane. Alkalis appear to lessen the transformation of glycogen into sugar, and they are used on this account in diabetes. Liquor potassæ sometimes helps to reduce obesity. Alkalis are used in the treatment of scrofula, rheumatism, gout, and lithiasis; but in the two last-mentioned lithia is considered the most valuable, whilst potash is preferred to soda, as the urate of lithia is most soluble, and the urate of soda least so. The salts of certain organic acids, such as the acetate or citrate, may be employed as remote antacids to render the urine alkaline, as they undergo combustion and are converted into carbonates in the blood. Alkalis are given to lessen the acidity of the urine in inflammation of the bladder or urethra, and potash is employed as a diuretic in dropsies. On account of its stimulating action on the heart and respiration, ammonia is administered in adynamic conditions and in chronic bronchitis.

T. Lauder Brunton.

ALKALOIDS and other ACTIVE PRINCIPLES.—Definition.—An alkaloid is a substance formed in the tissues of a plant or of an animal, having a definite composition as regards the proportions of the chemical elements of which it is composed, and capable of combining, like an alkali, with acids to form salts.

Besides alkaloids there are other active principles found in plants, which have also a powerful influence on the animal economy but do not possess all the chemical properties just stated.

Chemical Composition and Relations.—These are briefly expressed in the above definition. Thus morphia, one of the alkaloids of opium, has always the chemical composition represented by the formula $C_{17}H_{19}NO_3$, and it may unite with acetic acid to form acetate of morphia, just as potash may unite with the same acid to produce acetate of potash. But the empirical formula $C_{17}H_{19}NO_3$ represents only the percentage composition of the substance in the simplest numbers, and does not express how the atoms of the different elements are related to each other. For, just as ethylic alcohol, with the composition C^2H^6O, is believed by the chemist, from its behaviour towards other bodies, to contain a 'radicle,' or group of atoms, C^2H^5, having certain chemical properties resembling those of a base, such as potassium, K; and just as this radicle, C_2H_5 may replace one of the elements of water, so as to form alcohol ($C^2H^5 + H^2O = \frac{C^2H^5}{H}O + H$); so chemists have good reason for believing that alkaloids belong to the group known as *amines* or *amides*, which are really ammonia, NH^3, in which one or more of the atoms of hydrogen are replaced by a radicle or radicles. It is impossible, however, in the present state of knowledge, to represent the true chemical composition of alkaloids, the exact constitution of the radicles being still unknown.

It is obvious that two or more alkaloids may resemble each other in percentage composition, and still be very different, both in their chemical structure and, necessarily, in their physiological action. Thus strychnia, $C_{21}H_{22}N_2O_2$, quinia, $C_{20}H_{24}N_2O_2$, and cinchonia, $C_{20}H_{24}N_2O$, differ only in a few atoms of carbon or of oxygen, more or less; but they have different physiological actions, showing that their chemical structure, which is not indicated in these formulæ, must also be different. The physiological action of an alkaloid may also be modified by combining it with another substance. Thus, as was pointed out by Crum-Brown and Fraser, compounds of strychnia with methyl, ethyl, and amyl, do not present the well-known physiological action of that substance, but one analogous to that of woorara.

Enumeration.—The alkaloids and other active principles most familiar to the physician are:—Morphia, Apomorphia, Narceia, Codeia, Thebaia, Narcotin, Papaverin; Atropia, Hyoscyamia, Daturia; Nicotin; Conia; Physostigmia; Strychnia, Brucia; Quinia, Cinchonia, Beberia, Caffein; Aconitia, Veratria; Digitalin; Curarin; Muscarin; Santonin; and Ergotin.

Sources.—The majority of alkaloids are formed by plants. The function which they subserve in the economy of the plant is not known. Some plants produce only one alkaloid, while in others two or more may be formed. A few of the alkaloids have been produced synthetically by the chemist.

Physiological Action. — Alkaloids have various degrees of physiological activity when

introduced into the animal body. Many are slow in their action, and a large dose is required to produce any observable effect; while others act more rapidly, and are so potent that even a minute dose may destroy life. Compare, for example, narcotin, one of the alkaloids of opium, with nicotin, the alkaloid of tobacco. Twenty to thirty grains of the former have been taken by the human subject without producing any marked symptoms, while the twentieth part of a grain of the latter may induce symptoms so severe as to threaten death. It is also well known that alkaloids may have a different kind of action on different animals. Thus one-fourth of a grain of atropia will produce serious symptoms of a complex character in a dog, while three or even four grains may be given to a rabbit without causing any more marked effect than dilatation of the pupil. In considering the physiological actions of these substances the following generalizations may, in the present state of science, be made tentatively:—1. As a general rule, the more complex the organic molecule, and the greater the sum of the atomic weight, the more intense will be the action of the substance. This has been shown in experiments on the action of the chinoline and pyridine series of bases by McKendrick and Dewar. 2. Substances which split up quickly into simpler bodies, produce rapid but transient physiological effects, whereas substances which resist decomposition in the blood or tissues may produce no appreciable results for a time, but when they do begin to break up, the effects are sudden and violent, and usually last for a considerable time. 3. Alkaloids have frequently a double action on different parts of a great physiological system, and their action in a particular group of animals will depend on the relative degree of development of the parts of the system in that group. Thus most of the alkaloids of opium have such a double action—a convulsive action resembling that of strychnia, due to their influence on the spinal cord or on the motor centres in the brain; and a narcotic or soporific action resembling that of anæsthetics, due to their influence on sensory centres in the brain. Hence, in animals where the spinal system predominates, as in frogs, these alkaloids act as convulsants; while in the higher mammals their principal action is apparently on the encephalic centres, which have now become largely developed.

Passing to the consideration of the action of the individual substances, we cannot do more than give, by way of example, a brief *résumé* of our knowledge regarding a few of them.

1. **Morphia**—$C_{17}H_{19}NO_3$—an alkaloid of opium. In the frog this substance has an action resembling that of strychnia. At first there is a state of agitation, followed by tetanic spasms: finally, all reflex actions, including those of the heart and of respiration, are paralysed. Pigeons have been found to possess a remarkable power of withstanding the influence of this drug—an ordinary-sized bird requiring about two grains to kill it. Rabbits become partially somnolent, show a tendency to reflex spasms, and tolerate a large dose—say about one-half to one grain per pound weight of the animal. In the dog the intravenous injection of even one-tenth of a grain (for a small animal) causes agitation followed by sleep; the pulse and respiratory movements are slowed; the smaller arteries become (at least during one stage) contracted, so as to cause an augmentation of general blood-pressure: the pupil is contracted; and, if the dose be large, death may be preceded by convulsions. In the higher mammals morphia acts chiefly on the sensory apparatus, both peripheral and central.

2. Other alkaloids of opium have also been investigated.—(*a.*) **Narceia,** $C_{23}H_{29}NO_9$, is a pure hypnotic, causing profound sleep. Even in large doses it does not produce convulsions. (*b.*) **Codeia,** $C_{18}H_{21}NO_3$, has an action like that of morphia. (*c.*) **Thebaia,** $C_{19}H_{21}NO_3$, causes tetanic convulsions, thus resembling strychnia. (*d.*) **Narcotin,** $C_{22}H_{23}NO_7$, is slightly narcotic, but strongly convulsant. (*e.*) **Papaverin,** $C_{20}H_{21}NO_4$, causes a somniferous action like that of narceia. **Apomorphia,** $C_{17}H_{17}NO_2$, a derivative of morphia, has none of the characteristic actions of that substance, but acts chiefly as a vascular depressant and as an emetic. It is evident, therefore, that opium, which may contain more or less of all of these substances, must have an action on the body of a very complicated character.

3. **Strychnia,** $C_{21}H_{22}N_2O_2$,—the alkaloid of Strychnos nux vomica. In the frog very minute doses cause convulsions of all the voluntary muscles, excited by peripheral irritation. These convulsions are due to the action of the poison on the spinal cord, as they persist after decapitation. In warm-blooded animals the reflex character of the convulsions is less evident; they have more of a tonic character, and chiefly affect the extensors. The exact *modus operandi* of the poison on the cord is unknown, but in some way or other it heightens its reflex sensibility. Death is usually the result of asphyxia from arrest in spasm of the respiratory mechanism, but it may result from exhaustion. **Brucia,** $C_{23}H_{26}N_2O_4$, another substance found in nux vomica, appears to have an action like that of strychnia, but more feeble.

4. **Atropia,** $C_{17}H_{23}NO_3$, — the alkaloid of Atropa belladonna. In the frog it causes tetanic reflex spasms. Herbivorous animals, as a rule, have a tolerance of this poison, so that its effects are best studied in carnivora. Even in these the action is somewhat uncertain. Respiration may be paralysed without general convulsions: the pulse is quickened by paralysis of the inhibitory action of the pneumogastric nerve on the heart; and the arterial pressure is increased. After very large doses the arterial pressure may be diminished with paralysis of all parts containing involuntary muscular fibre. Secretion is diminished. The pupil is dilated apparently by a direct influence of the poison on the centres or nervous arrangements in the iris itself, as the effect may be observed even in an eye removed from the head. **Hyoscyamia,** the alkaloid of Hyoscyamus niger, and **Daturia,** the alkaloid of Datura stramonium, have an action like that of atropia.

5. **Digitalin,** $C_{27}H_{44}O_{15}$,—the active principle of Digitalis purpurea. A large dose causes slowing of the heart's action, and if the dose be increased the heart will be arrested in diastole.

and will not respond to direct excitation. With medium doses there is a period of acceleration of the heart's action, but this period may rapidly pass into that of slowness just mentioned. This action on the heart has not yet been clearly accounted for, and it remains to be decided whether it be due to the influence of the drug on the terminations of the pneumogastric, or of the sympathetic, or on the intracardiac ganglia themselves. Coincident with the action on the heart, the smaller arteries are contracted and the arterial tension is increased. Digitalis would appear to have little effect on involuntary muscle, but it exerts a potent action on voluntary muscle, which, after small doses, becomes feeble in contractile power, while large doses may abolish contractility altogether.

6. **Physostigmia**, $C_{15}H_{21}N_3O_2$, — the active substance of Physostigma venenosum, or Calabar bean. As has been pointed out by Professor Fraser, this alkaloid has an action antagonistic to that of atropia. Sensibility and consciousness remain until death; the voluntary muscles are paralysed; involuntary muscles are said to show tetanic contractions; respiration is at first accelerated, and afterwards slowed; the vessels become alternately dilated and contracted; secretion, especially that from the lachrymal and salivary glands, is increased; and the pupil is contracted. It appears to paralyse the extremities of the motor nerves, in this respect resembling curare.

7. **Curare** is a resinous substance, containing an alkaloid, **Curarin**, of the composition $C_{10}H_{15}N$, obtained from certain parts of South America, and used by the natives of these regions as an arrow-poison. It is probably obtained from certain plants belonging to the genera Strychnos and Paullinia. Its distinctive physiological action is abolition of the power of all voluntary movement, in consequence of its action, as was proved by Claude Bernard, upon the peripheral terminations of motor nerves—the "terminal plates" of muscle. Respiratory movements are arrested in consequence of paralysis of the muscles of respiration, but the heart may continue to beat for a considerable time. If artificial respiration be established, the circulation may be maintained for several hours while the animal is completely under the influence of the substance. All the secretions are increased, and the mean temperature falls.

8. **Muscarin**, the alkaloid of Agaricus muscarius, causes arrest of the heart's action in diastole, an effect which may be removed by the influence of atropia, thus affording an instance of physiological antagonism. In warm-blooded animals muscarin slows the heart's action; the blood-pressure falls; respiration is first embarrassed, and may be completely arrested; parts containing involuntary muscle are in a state of tetanic spasm; the pupil is contracted; and secretion is increased.

9. **Santonin**, $C_{15}H_{18}O_3$, the alkaloid of Artemesia santonica, may cause in man nausea, vomiting, hallucinations, vertigo, and a peculiar state of visual sensation—the field of vision usually appearing yellow, but sometimes violet. It is said that the stage of violet rapidly passes into that of yellow, and therefore it is probable that santonin may first excite the retinal fibres sensitive to violet (according to Thomas Young's theory of colour-perception), and afterwards paralyse them. In large doses, santonin causes loss of consciousness, tetanic convulsions, and death.

10. **Ergotin**, the active principle of Secale cornutum, causes contraction of the smaller blood-vessels, contractions of the uterus, and slowing of the pulse; and the animal may die in consequence of arrest of the action of the heart.

11. **Quinia**, $C_{20}H_{24}N_2O_2$, one of the alkaloids of Cinchona, in small doses accelerates the heart's action in the warm-blooded animal; in moderate doses it slows it; and in large doses it may arrest it, and cause convulsions and death. Research shows that its action is essentially upon the central nervous system. It destroys all microscopic animal organisms, apparently killing vibrios, bacteria, and amœbæ; but it seems to be without action on humble organisms belonging to the vegetable kingdom. It arrests the movements of all kinds of protoplasm, including those of the colourless corpuscles of the blood. It arrests fermentive processes which depend on the presence of animal or vegetable organisms, but it does not interfere with the action of digestive fluids.

12. **Cinchonia**, $C_{20}H_{24}N_2O$, is said to have an action similar to quinia, but much more feeble. Further research is needed on this point.

JOHN G. MCKENDRICK.

ALOPECIA. *See* BALDNESS.

ALPHOS and **ALPHOIDES** (ἀλφός, white), terms signifying white and white-looking, are associated with the whiteness of the disks of common *Lepra*: hence *Lepra alphos* and *Lepra alphoides*. *See* LEPRA.

ALPHOSIS (ἀλφός, white).—Whiteness, or the process of turning white. *See* ACHROMA.

ALTERATIVES.—DEFINITION.—Medicines which gradually restore the nutrition of the body to a healthy condition, without producing evacuations, or immediately exerting any very evident action upon the nervous system.

ENUMERATION.—The principal alteratives are —Nitric and Nitro-hydrochloric acids; Chlorine and Chlorides; Iodine and Iodides; Sulphur and Sulphides; Potash and its salts; Mercury and its salts; Phosphorus; Hypophosphites; Antimony; Arsenic; Taraxacum; Sarsaparilla; Hemidesmus and Guaiacum; Mezereon and Dulcamara.

ACTION.—Healthy nutrition depends on the digestion of the food, its assimilation by the tissues, the decomposition of the tissues during the exercise of their functions, and the removal of their waste products being performed in a proper manner—in due proportion one to another. If the food is not properly digested, as in dyspepsia; or is not properly assimilated, as in diabetes: if the tissues break up too rapidly, as in fever: or if the waste products are not properly removed, as in some cases of kidney-disease, nutrition suffers. Digestion and excretion may be improved by tonics, purgatives, and diuretics; but alteratives seem to exert their action upon assimilation and tissue-change. The digestion of food is effected by means of ferments, such as

those of the salivary glands, stomach, pancreas, etc. Some also of the changes, such as the conversion of glycogen into sugar, which the food undergoes after absorption in the liver, and even certain so-called vital actions—such as the coagulation of the blood—are produced by a similar agency. It is not improbable that the histolytic changes in the tissues are also effected by ferments. They do not depend upon oxidation, for although during health the products of tissue decomposition are oxidised as fast as they are formed, yet under certain circumstances the tissues are split up so rapidly that the products which they yield are only partially oxidized. This is seen in poisoning by antimony, arsenic, and still more markedly by phosphorus, where such tissues as the muscles become decomposed, yielding nitrogenous substances, such as leucin, tyrosin, or urea, and fat. The former are excreted in the urine; while the last, instead of undergoing combustion, accumulates in the place formerly occupied by the muscular tissue, which is accordingly said to be in a state of fatty degeneration. It is possible then, although by no means certain, that alteratives influence nutrition, either by modifying the activity of ferments, or by altering the susceptibility of the tissues to their action.

Mercurials in purgative doses, taraxacum, nitric and nitro-hydrochloric acids, probably act by modifying the digestion of the food in the upper part of the small intestine, or by affecting the changes which it undergoes in the liver after absorption. Potash has probably an action on the muscles. Antimony, arsenic, and phosphorus especially affect the nervous and cutaneous systems. Mercury has a peculiar power of breaking up newly-formed fibrinous, and particularly syphilitic deposits. Iodine, iodides, and probably chlorides, act upon the lymphatic system and promote absorption.

Uses.—Purgative doses of mercurials, taraxacum, nitric and nitro-hydrochloric acid are useful in cases of frontal headache, general malaise, and depression of spirits, associated with symptoms of so-called biliousness, or with the appearance of urates or of oxalates in the urine. Potash and colchicum are employed in the treatment of gout. Phosphorus and arsenic are used in cases of nervous debility, as well as in nervous diseases, such as neuralgia and chorea, in which antimony is also serviceable. Arsenic is also given in diseases of the skin; and antimony in inflammation of the mucous membrane of the bronchi. Mercury in alterative, that is, in small doses, which are absorbed into the circulation without purging, is used to break up newly-deposited fibrinous masses, as in iritis, pericarditis, etc., and to counteract the effect of syphilitic virus upon the soft tissues in the secondary stage of this disease. Iodine and iodides act on the lymphatic system, and are useful in removing glandular swellings. By stimulating the absorbent system they may also assist in the removal of the fibrinous deposits and syphilitic growths disintegrated by the mercury. The iodides are sometimes given in the secondary, but are still more valuable in the tertiary stage of syphilis.

T. Lauder Brunton.

ALVEOLAR.—A word used in pathology as descriptive of any morbid growth which consists of small cavities or spaces (*alveoli*), usually occupied by contents, and bounded by walls formed of cells or fibres. Alveolar Cancer is the most familiar application of the term, being a synonym for Colloid Cancer. *See* Cancer.

AMAUROSIS (ἀμαυρὸς, dark).—Definition.—This term cannot be strictly defined. Literally, it means an *obscurity of vision*, a state of *blindness*, in the popular sense of the term, whereby nothing more is learnt than that the patient cannot see well enough for practical purposes, and is thereby unfitted for the usual occupations of life. Besides this, it is always tacitly understood that an external observation of the organ of vision, during the life of the patient, does not reveal any ostensible cause of blindness. It is further understood that the use of glasses is no remedy in amaurotic cases It is rather the kind, than the degree, of blindness that is called amaurotic; but it must be observed that lesser degrees of blindness, of the amaurotic type, are generally, vaguely and indefinitely, called *amblyopic*. To add to the obscurity of the subject, some writers call some cases of moderate blindness, of the amaurotic kind, *amaurotic amblyopia*; others speak of *partial* or *incomplete amaurosis*. We now estimate any defect of vision with more accuracy, and record its area on a map, and its degree in figures, in comparison with a standard of ordinary normal vision.

Ætiology.—The causes of amaurosis have been more recently specifically attributed to morbid conditions of the percipient nervous apparatus of the eye or of vision. All cases are excluded in which, in the present state of science, and using the ophthalmoscope, we can *see* any morbid condition. But very few cases are now, in the statistical tables of the chief eye-hospitals, included under the head *amaurosis*. Some few cases seem likely, at least for some time to come, to be called by this term of reproach. The ophthalmoscope has enabled us more accurately to classify a large majority of the cases formerly called amaurotic. Many new names are thus introduced to our systematic treatises on eye diseases, whereby we gain more definite information, if only, as in *some* of them, *e.g.* 'white atrophy,' we have substituted the name of a particular ophthalmoscopic sign for an indefinite symptom. At least we can speak more accurately of the part that is or has been diseased—of the retina, or of the ocular end of the optic nerve. And, indeed, before the invention of the ophthalmoscope, the ancients, whilst professing to include only cases of disease of the percipient nervous apparatus of vision, included all kinds of obscure visual disorders. Mackenzie (1854) includes, besides retinitis, etc., choroiditis, and dislocated lenses! Of the first named he says, 'It would be superfluous to consider these states separately, because we are at present ignorant of any diagnostic signs by which, during life, the one can be discriminated from the other.' Even now, whenever the term amaurosis is had recourse to, it expresses more particularly that of which we are ignorant, and it may mean any one of so many different states that

no anatomical characteristics can be assigned to it.

In a large majority of the cases commonly classed as those of amaurosis, it is found ophthalmoscopically that there is 'white atrophy' of the optic nerves. The 'disks' are nearly or quite bloodless; white, not pinky-white; and the nerve-fibres going to the retinæ, being more or less wasted, there is some excavation of the disks, perhaps so much that the lamina cribrosa, in one or both, is exposed to view, while the retinal vessels are somewhat diminished in size. The causes of this condition are, most commonly, intracranial tumours or other diseases which induce pressure upon the optic nerve, or lead to an extension of inflammation, followed by œdema or double optic neuritis (descending), these terminating in the atrophy and amaurosis. The nerve-disease is often due to syphilis. But some cases of white atrophy occur, in which there has been no precedent neuritis. Of such 'tobacco amaurosis' is an example, in which, unless smoking be given up, by an idiosyncrasy of the patient, he soon becomes blind. But nerve-atrophy or inflammation should be no longer called amaurosis—they have obtained a better nomenclature. The preceding stages of the diseases causing them, if, as is rarely the case, unaccompanied by any definite ophthalmoscopic signs, and yet producing a considerable amount of blindness, may, for want of better knowledge, at present be called *amaurotic*. Other such cases are those reported as snow-blindness; or in which blindness has been produced by a lightning-flash near the eye; a blow on the eye without other mischief resulting; disuse of an eye in children, as in some neglected squint cases; irritation from some branches of the fifth nerve (dental caries, etc.); anæmia after excessive losses of blood; suppression of menses; blood-poisoning by tobacco, lead, quinine; uræmia; and some cases of cerebral apoplexy. Embolism of the central artery of the retina occurs, but it is easy of diagnosis with the ophthalmoscope, and therefore should not be called amaurotic. The writer does not think there are any cases of *long-standing* blindness that show no ophthalmoscopic changes.

Symptoms and Diagnosis.—There is one symptom of amaurotic blindness, affecting both eyes, which is noteworthy, as constituting, *primâ facie*, a general distinction between it and the other cases of blindness *not* of nervous origin: the gait and general aspect of the patient is peculiar—he is hesitating and hopeless-looking. He no more *tries* to see objects. He holds up his head; the eyes are open and turned upwards, as eyes not in use (in sleep) always are, or because the patient has felt the heat of the sun from overhead, and has last enjoyed sensation of light, whence he knows it comes, from above. He feels his way with his feet, and his hands are extended before him. He does not look towards you, or at anything in particular. But amaurosis does not by any means imply a similar state of vision in both eyes, nor that the blindness is to be taken in the ophthalmological sense, *i.e.* wanting perception of light. It would be well if any less degree of imperfection of vision, without evident cause, might be called *amblyopic*, but the two eyes must be considered separately. To diagnose the absence or presence of a power of perception of light, certain important precautions must be taken, as almost all patients who are absolutely blind will declare, and probably believe, that they still can see light, *i.e.* objective light. The patient should be placed opposite to a bright light, such as a gas-lamp, and near to it, but not so near that he can feel the heat of it; the light is then turned up and down, and it is fully exposed and obscured, and the patient is asked many times, in quick succession, if he sees light or not. The light should be left burning and exposed, or not, during several of the successive queries, so as to do away with any doubt. The word of the patient untested is quite inadmissible. Any other blindness than this of absolute amaurosis, or originating in any other diseases than those of the percipient nervous apparatus of the eye, is never so great as to prevent the perception of light. If the patient can see light from darkness, test whether he can see shadows of some small object—of the hand, or of one finger only, passed between him and the burning light, or the light of the window only. If he can see to count fingers, his blindness is insufficient to indicate what is called amaurosis. Another point in the diagnosis of amaurosis is that, ophthalmoscopically, the appearance of the fundus of the eye is normal, or such as, independent of errors of refraction, we find in other cases compatible with standard vision, or at least with a fair amount of useful vision. This will allow of a considerable latitude, and will not include any slight or imaginary hyperæmia or anæmia of the optic disk, any physiological excavations of the same, or congenital opacities of the retina, etc. The pupil of the affected eye is, if the other be perfectly excluded from light or vision, nearly always dilated, to almost the greatest extent, though atropine dilates it yet more fully, and it is fixed, being insensible to light.

Prognosis.—After a due consideration of the cases thus classed together—and they are very unlike in fact, and often very obscure—we may say generally, that if the blindness be of one eye only, sudden and recent, the prognosis is hopeful; but if both eyes are affected, and the disease, whatever it may be, is of steady progress and of long standing, it is very serious. The cases of amaurosis are very rare indeed in which vision is perfectly restored; most of them end fatally to vision, or would so end but that the disease is sooner fatal to life.

Treatment.—This must necessarily be varied according to the cause of the amaurotic condition. For instance, if there is intra-cranial disease, treatment directed thereto must be followed out; and should there be indications of syphilis, iodide of potassium and small doses of mercury must be given for some time. When amaurosis depends on any injurious habit, such as smoking, this must be relinquished. Large doses of strychnine and iron are useful in advanced white atrophy. J. F. Streatfeild.

AMBLYOPIA (ἀμβλὺς, blunt, and ὤψ, sight).—Obscurity of vision. *See* Amaurosis.

AMBULATORY (*ambulare*, to walk).—A term applied to latent typhoid fever, signifying that the patient is able to walk about during the attack. *See* TYPHOID FEVER.

AMENORRHŒA (ἀ, priv.; μὴν, a month; and ῥέω, I flow).—Absence of the menstrual flow during any portion of the period of life when it ought to be present. *See* MENSTRUATION, Disorders of.

AMENORRHŒAL INSANITY. *See* INSANITY.

AMENTIA (ἀ, priv., and μένος, the mind).—An obsolete term for Dementia. *See* DEMENTIA.

AMNESIA (ἀ, priv., and μνῆσις, memory). *See* APHASIA.

AMPHORIC.—A peculiar hollow metallic sound, elicited occasionally by percussion, but more commonly heard in auscultation. Amphoric breath-sound resembles that produced by blowing into a large empty glass or metallic vessel (*amphora*). *See* PHYSICAL EXAMINATION.

AMYGDALITIS (*amygdalæ*, the tonsils).—A synonym for inflammation of the tonsils. *See* TONSILS, Diseases of.

AMYLOID DISEASE (ἄμυλον, starch).—The name given by Virchow to Albuminoid Disease, from the belief that the material characteristic of this morbid condition is of the nature of starch or cellulose. *See* ALBUMINOID DISEASE.

ANÆMIA (ἀ, priv., and αἷμα, blood).—SYNON.: *Spanæmia; Hydræmia*; *Oligæmia*; *Aglobulism*. Fr. *Anemie*. Ger. *Anämie*; *Blutarmuth*.

DEFINITION.—Deficiency of blood in quantity, either general or local; also, deficiency of the most important constituents of blood, particularly albuminous substances and red corpuscles.

This definition is purely pathological, and the condition thus expressed presents many varieties, Anæmia in the widest sense of the term including Oligæmia, Oligocythæmia, Hydræmia, and Spanæmia, as well as Chlorosis. (*See* CHLOROSIS, HYDRÆMIA, SPANÆMIA, OLIGOCYTHÆMIA, and BLOOD, Morbid Conditions of.) From the clinical point of view, Anæmia is a condition of system in which impoverishment of the blood, whether from want or from waste, is associated with symptoms of imperfect discharge of the vital functions.

ÆTIOLOGY.—The causes of anæmia are generally multiple and complex. First, the *supply* of blood to the body may be insufficient, and that from a variety of causes, of which the chief are:—derangements of alimentation, including insufficient food, and morbid states of the lymphatic and blood-glands; such defective hygienic conditions affecting the formation and nutrition of the blood as want of light, air, and muscular exercise; prolonged exposure to the influence of certain poisons, as lead, mercury, and malaria; and, lastly, interference with the free circulation of the blood by cardiac or vascular disease, such as valvular disease or dilatation of the heart and aneurism of the aorta. Secondly, the *consumption* of blood may be increased by hæmorrhage; by profuse discharges, such as suppuration, catarrh, and albuminuria; by rapid growth and development; by frequent pregnancy and superlactation; by excessive muscular exertion; and by the presence of pyrexia, or of new growths, which rob the system of nutritive material. In a third group of cases of anæmia both the supply and the consumption are at fault. Thus derangement of the organs and of the whole process of sanguification is frequently associated with profuse discharges from various parts; and in malignant diseases and the 'chronic constitutional diseases,' such as syphilis, tuberculosis, Bright's disease, albuminoid disease, Addison's disease, and others, the cause of the anæmia is extremely complex. But the majority of the cases of anæmia that are regarded and treated as such fall into the class to which the name of *idiopathic* has been applied. In such cases the anæmic condition is due, not to any disease so-called, but to disturbance of nutrition generally, that is of the healthy relation between the demands of the system and the supply of nutrient material. This condition occurs chiefly in children and young women, at the period of bodily growth and of the development and early activity of the sexual functions; and when, as so frequently and unfortunately happens, the air, light, food, occupation, and moral relations of the individual are all more or less unhealthy.

ANATOMICAL CHARACTERS.—The blood suffers three principal changes in declared anæmia, namely, (1) deficiency in amount (Oligæmia); (2) deficiency in red corpuscles or hæmoglobin (Oligocythæmia, Aglobulism); and (3) deficiency in albuminous constituents (Hypalbuminosis). Of these Oligæmia is the simplest, and perhaps never occurs alone; it is speedily complicated with Aglobulism, which is a very early and common, as well as the most obstinate, change in the blood. Hypalbuminosis is the most advanced and perhaps the most serious alteration of the three. (*See* BLOOD, Morbid Conditions of.) The blood is scanty and pale, and has a diminished specific gravity; and coagulates slowly and loosely, or in aggravated cases not at all, settling into three layers—consisting respectively of red corpuscles, white corpuscles, and plasma. The body presents certain changes directly due to the state of the blood. Whether the anæmia be local or general, the corresponding parts are blanched and 'bloodless.' The cells of the tissues become atrophied and degenerate, in consequence of, and in proportion to, the interference with their plastic and functional activity respectively; and the so-called 'anæmic' form of fatty heart, liver, kidneys, and other organs, is the result. If death occur suddenly from acute anæmia the heart is found empty and contracted.

PATHOLOGY.—When the volume of blood in the body has been reduced by repeated small hæmorrhages, the phenomena that supervene, while they express the want of blood as a whole, and of its several constituents, are chiefly referable to the loss of two of these constituents—the albuminous substances and the red corpuscles or hæmoglobin—that is, of the oxidisable and the oxidising materials. The pathology of hypalbuminosis and aglobulism is fully discussed in the article on diseases of the blood, and need not be

repeated here. The same effects will be produced by a drain of the liquid part only of the blood, or by poverty of the blood from any of the causes enumerated above, whether of the nature of waste or of want; inasmuch as loss of plasma speedily affects the nutrition of the red corpuscles. These phenomena constitute the symptoms of the anæmic condition whatever may be its cause; their relative prominence naturally varying according to an immense number of circumstances.

Symptoms.—The subjects of anæmia are usually girls and young women. Their general appearance, which is striking, is one of pallor, debility, and variable loss of feminine fulness. The visible parts of the surface are pallid, often with a tinge of dusky brown on the eyelids and the backs of the hands; the clearness of the complexion varies with the normal pigmentation of the body; the skin is soft, satiny, and rather loose. The mucous surfaces also are blanched; the sclerotic is pearly blue. The loss of flesh may be moderate, or it may be considerable. The extremities are cold, and the legs and lower eyelids are often œdematous. Bodily strength is reduced; muscular force is diminished, while myalgia is common; an air of languor and want of vigour pervades the whole demeanour; and the patient is sleepy, dull, and depressed. The subject of anæmia generally complains of weakness, various pains about the body and head, and marked shortness of breath on the least exertion. The last symptom is unaccompanied by other evidence of respiratory derangement; in character the breathing is regular, and short or even panting. The symptoms referable to the circulation consist chiefly of palpitation on exertion; a tendency to faint; and pain or even distress over the cardiac region. The impulse is variable; the first sound is either hollow or murmurish, or converted into a murmur at the base, and frequently even over the whole præcordium; the diastolic sound is sharp generally. Over the manubrium and in the cervical vessels a murmur followed by a sharp sound is commonly audible, and therewith a venous hum. The cervical vessels may throb; the radial pulse is small, soft, weak, and of variable but usually increased frequency and suddenness. There is a tendency to hæmorrhages, especially epistaxis; and petechiæ are occasionally observed. The digestive system is markedly affected, as shown by loss or perversion of appetite; an anæmic, often bare, but variable tongue; dyspepsia, nausea, and sickness after meals or on rising; and constipation, which is present in the majority of cases and is frequently prolonged and severe. The menstrual functions are almost always deranged; amenorrhœa is common in some form; menorrhagia is rare (except as a cause of anæmia); dysmenorrhœa is frequently associated; and leucorrhœa is the rule. The urine is usually abundant and pale, but varies greatly. Headache and other cerebral symptoms are common. Blood drawn from the finger presents aglobulism. *See* Hæmacytometer.

The leading phenomena of *acute* anæmia are those of syncope, or suspended animation from failure of the circulation, and are described under that title.

Course and Terminations.—The course of anæmia in this form is essentially slow and progressive, unless it is checked; the *duration* is perfectly indefinite. The course of the symptomatic form will naturally vary with its cause. Idiopathic anæmia rarely terminates fatally; and, when it does so, the event may be referred with few exceptions to some complication. Occasionally, however, it proceeds steadily to death (*see* Progressive Pernicious Anæmia, below).

Intercurrent diseases may be expected to be severe in an anæmic condition, in proportion to its degree.

Diagnosis.—Anæmia is generally recognised with the greatest ease, and the chief question of diagnosis relates to its *cause*. The first point to be determined, therefore, is whether it is not *symptomatic* of some more grave state, such as tuberculosis, syphilis, albuminoid disease, or some other of the many possible causes of poverty of blood. Having settled that the anæmia is *idiopathic*, we must next exclude two diseases with which it may be confounded, namely, chlorosis and leukæmia. Chlorosis, in which the plasma is not considered to be altered, and which possesses otherwise a special pathology, is expressed by the yellow tint of skin, by the absence of wasting and of dropsy, as well as by other features (*see* Chlorosis.) Leukæmia is recognised by examination of the blood, spleen, and lymphatic glands. The starting-point of the blood-change in cases of idiopathic anæmia, can only be discovered by careful investigation of all the facts of the case.

Prognosis.—The prognosis of anæmia is favourable as regards life. In simple anæmia from loss of blood, the patient may be assured of speedy and complete recovery. In idiopathic anæmia, however, this promise can be given only when the cause can be removed or avoided. Under favourable circumstances and sound treatment, improvement will begin almost immediately; and health should be restored after a few weeks or months.

Treatment. — The treatment of anæmia, when it is symptomatic of some more grave condition, such as Bright's disease or phthisis, does not require notice here. When blood has been lost in serious quantity, without other injury of consequence, it will be naturally restored if sufficient time but be given and interference otherwise avoided. Attention to the ordinary rules of health, abundance of food and air, and moderate exercise, will surely, if slowly, restore the patient, without the administration of a single drug. Even in this case, however, treatment may be of great service, by arresting, if necessary, the cause of the anæmia, such as menorrhagia or epistaxis; and by assisting nature, if the condition should threaten at any time to become intensified by its own effects.

But before the blood can be restored in the large and ill-defined group of cases known as idiopathic anæmia, the unhealthy influences under which the patient is placed, and the functional and other derangements, which are usually accountable for the imperfect sanguification, must be discovered and corrected. Where the ætiology is complex, treatment must be equally general, and the whole system of life will have to be reformed. On the other hand, in the rapidly growing child

and youth, and still more in girls at puberty, the great demand for nutritive material must be duly considered and every obstacle to its supply removed. When other than direct discharges are draining the blood they must be checked. Lactation may have to be forbidden; and leucorrhœa and spermatorrhœa will sometimes demand local treatment.

The removal of the cause being thus made the first element in treatment, means must next be adopted for the restoration of the blood. But before this can be accomplished, it will be necessary to bring the alimentary tract and the organs of sanguification into a healthy state. Dyspepsia and constipation require immediate treatment; and for this purpose simple alkaline and bitter stomachics with rhubarb, and free purgation by ordinary means, followed by a course of aloes and iron pill at night, are the best. The food must be carefully ordered, so that it shall not only supply the albuminous elements that are specially deficient in the blood, but be retained and absorbed; it must therefore be at once nourishing and digestible, and be taken in small quantities at frequent intervals. The patient must not be allowed to yield to the disgust that she may have for meat.

The process of sanguification may be successfully assisted by means of drugs. Iron is the sovereign remedy for aglobulism; and, practically speaking, it speedily becomes a question in the treatment of a case of anæmia in what form iron is to be given. The compound iron mixture of the pharmacopœia answers more frequently than any other; but, on the one hand, when there is much constipation, the protosulphate with purgative saline sulphates will be more suitable for a time; and, on the other hand, when there is a tendency to discharges, the per-salts with bitters will better answer the purpose. The combinations of iron with quinia or strychnia, should be given in cases where less marked anæmia occurs in older subjects with nervous depression and general want of vigour. In special cases the ferrum redactum, saccharated carbonate, vinum ferri, or the French *dragées ferrugineuses* at meal times may be ordered. Cod-liver oil may sometimes be prescribed with success. Other symptoms must be treated on ordinary principles. Uterine complaints demand special attention; and bromides, ergot, opium, and other sedatives and astringents are indicated where excitement and excessive discharge are present. While these dietetic and medicinal measures are being carried out, it is impossible to insist too strongly upon attention to bodily and mental hygiene. In a large number of cases change of air fulfils all the necessary conditions, and it is generally to be recommended. Above all, time is an essential element in the cure; and rest is scarcely less so. A frequent change in the form of the medicinal remedies is also advisable.

Progressive Pernicious Anæmia. — A peculiar form of anæmia has long been known, but has lately attracted special attention, and is variously designated as *pernicious*, *malignant*, *idiopathic*, and *progressive*, on account of the intensity of the symptoms, the obscurity of its pathology, and the frequency with which it advances to a fatal termination. This disease may occur in both sexes, but has been most frequently observed in middle-aged, pregnant women; it presents no special post-mortem appearances; and it cannot be referred to any reasonable cause. The *symptoms* are those of excessive anæmia, as described above; but gastric disturbance and general hæmorrhages are relatively prominent, and, in some cases, irregular attacks of pyrexia occur. The blood during life is said to differ from that found in ordinary anæmia, by containing an unusual amount of ill-shaped red corpuscles and granular matter. The *course* of the disease is steadily towards death, in which it generally terminates. The *pathology* of progressive pernicious anæmia is obscure. It is believed by some to be but the advanced stage of ordinary anæmia, which attracts attention by its resistance to treatment, and its fatal termination. The appearance of the blood would seem to indicate excessive destruction, rather than insufficient supply of the important elements, as the essential cause of the morbid condition; but there is probably derangement in both directions. The *prognosis* is as unfavourable as possible. *Treatment* must be ordered on general principles: transfusion has been frequently tried, but without success. J. Mitchell Bruce.

ANÆMIA LYMPHATICA.—A form of Anæmia which is associated with a peculiar affection of the Lymphatic System. *See* Hodgkin's Disease.

ANÆSTHESIA (ἀ, priv., and αἰσθάνομαι, I feel).—Anæsthesia literally means absence or loss of sensation, which may be general or local. The word is, however, more especially employed to signify loss of tactile sensibility, as distinguished from insensibility to pain or *Analgesia*. It is further used to indicate the condition induced by the action of Anæsthetics upon the system. *See* Sensation, Disorders of.

ANÆSTHETICS.—Definition. The name given to a series of agents which are employed for the prevention of pain, but more especially applied to those used in surgical practice.

History.—The idea of annulling pain in surgical operations is a very old one. Compression of the nerves and blood-vessels, and the inhalation of the vapour of mixtures containing carbonic anhydride were practised at an early date. In the sixteenth century ether was probably the active ingredient of a volatile anæsthetic described by Porta. The use of anæsthetics was, however, but little understood and rarely practised. Even the suggestion of Sir Humphry Davy, that nitrous oxide should be used in minor operations not attended with loss of blood, was of little practical value, on account of the inefficient apparatus then available. In 1845 Horace Wells inhaled laughing gas so successfully that he may be said to have introduced the practice; but he appears to have so often failed to produce the desired effect that this agent fell into disuse on the introduction of ether in 1846 by Morton, after some communication on its properties from a chemist named Jackson. In 1847 chloroform was used by Simpson, and quickly superseded ether almost all over Europe. At the present

time the comparative safety of ether has caused this anæsthetic again to be preferred by many surgeons in this country.

Enumeration.—The three agents just mentioned, namely, nitrous oxide, ether, and chloroform, are those chiefly in use, and they have each advantages in particular cases. Experiments made with other agents, such as amylene, tetrachloride of carbon, ethidenedichloride, and bichloride of methylene, have not shown that they possess sufficient advantages to counterbalance the defect of requiring special management in their administration. This list of anæsthetics might be still further increased, for in order to produce insensibility it is only necessary to reduce the supply of arterialised blood to the nervous centres, or to introduce into the blood a substance which deprives it of its power of oxygenating the tissues.

Modes of Use.—Anæsthesia may be produced for surgical purposes:—1. by benumbing the part to be operated on by means of cold; 2. by intercepting its nervous communication; 3. by arresting the activity of the nervous centres concerned in sensation. Thus anæsthetics may be *local* or *general* in their action.

Local Anæsthesia may be induced by cold. The most convenient plan is to blow a jet of anhydrous ether spray upon the part, as suggested by Dr. Richardson, and thus to freeze it. The surface to be frozen should be dry, and hence the difficulty of freezing the gum of the lower jaw, on account of the saliva. A mixture of equal parts of pounded ice and common salt contained in a bag of muslin is effective, but less easily applied. This plan is adapted for opening abscesses and boils, and for the extraction of a few teeth; but the process both of congelation and of thaw is painful. Chloroform applied locally is said to cause numbness, but it is very little used except inside the mouth, and then it owes its soothing effects to the quantity of chloroform vapour which is inhaled. Compression of nerve trunks for inducing anæsthesia is never practised at the present day.

General Anæsthesia is at present rarely obtained in any other way than by inhalation, although successful attempts have been made to induce the condition by subcutaneous and intravenous injection of chloral or morphia.

Subjects for Anæsthetics.—We may say generally that any person fit for a severe operation is a fit subject for an anæsthetic, but no one is so free from danger that care in watching its effects can be dispensed with. The cases requiring the greatest vigilance are not the young and delicate, for whom a small dose suffices, but the strong, who inhale deeply and struggle much. Ether is probably better for those suspected of fatty degeneration of the heart, although as a rule such cases are eminently satisfactory under chloroform. Many of the deaths under chloroform have occurred in intemperate drinkers, and the presence of alcohol in the system undoubtedly intensifies its effect.

Precautions.—Before commencing inhalation the following particulars should be attended to. The patient must not have recently taken a full meal; he should lie comfortably, in a horizontal position if possible, unless when gas or ether is given for a short operation; and the dress should not be tight. When the administration is begun, he should be encouraged to breathe regularly and freely. The pulse as well as the respiration must be watched. If the vapour excites either swallowing or coughing, it is more pungent than is requisite, and its strength should be diminished. Most patients are at first afraid of breathing, and some hold their breath for half a minute. The vapour should not be removed on this account, but care should be taken, by holding the inhaling apparatus farther off, to prevent the vapour becoming too strong in the interval. After volition has been abolished, any pause in the breathing should be noted, and more or less fresh air given. Further directions will be given in describing the anæsthetics specially.

Special Anæsthetics.—*Protoxide of Nitrogen, Nitrous Oxide, or Laughing Gas.* This agent is now prepared wholesale, and sold condensed into a liquid in strong iron bottles. The gas, whether supplied thus or from a gasometer, should be inhaled from a bag having such a free communication with the face that it will readily be supplied even in panting respiration. A long tube, however large, is objectionable, as the gas is less mobile than common air.

The special aim in giving gas should at first be to exclude air, and to exchange the atmosphere within the air-passages and lungs for one of pure gas. The patient should not merely be told to breathe slowly and deeply, but be shown how to do so, about fifteen times in a minute. The inspiration should not be jerking, and the expiration should be complete. It is a special merit of laughing gas that no harm can come of inhaling too freely at first. The gas-bag must be kept filled either by pressure on the gasometer, or by turning the screw tap of the gas bottle. This may be done by the hand of an assistant, or more conveniently with the foot of the administrator, by means of a contrivance invented by Mr. Braine, in which the gas-bottle is placed horizontally upon rollers and moved by the foot whilst the head of the screw is fixed. The writer's plan is to fix the bottle vertically and turn the screw by pressing the foot against an iron plate with spikes on its upper surface, and a square hole fitting the tap on its lower surface. It is imperative that the face-piece or mouthpiece *should fit accurately*, and the air-pad is almost essential to effect this in a great many cases. It should be warmed if the indiarubber is stiff. After five or six good respirations there is no need of supplying fresh gas with each inspiration. The expiring valve should be kept closed, and the inspiring valve opened. Care must always be taken that the supply of gas is sufficient to replace any that is lost by absorption into the blood or by leakage. This is more easily effected if the gas-bag is made of thin indiarubber, so as to distend easily and contract gently with the movement of breathing. It should be sufficiently filled, so that if the mouth-piece does not fit, the gas would escape instead of air entering and becoming mixed with it.

Lividity of the skin will not help us to know when the patient is fully under the influence of the gas, neither will insensitiveness of the eyelids, nor yet the state of the pupils. The breathing

should become stertorous or interrupted, or the pulse very feeble, or convulsive twitchings should occur, before the face-piece is removed. A little air may be admitted by raising the face-piece, if the operation is not upon the face, and by doing so every fourth or fifth respiration anæsthesia may be kept up for several minutes. The effect of a single full inspiration may be to bring the patient into a state of excitement, and the continuance of the gas *without* air brings on convulsive movements, so that it is not well adapted for any operation lasting as much as five minutes, and requiring steadiness.

Patients are sometimes so unsteady that it is found to be almost impossible to make the face-piece fit. In such cases the best plan is to cover the patient's eyes and let him breathe air, merely preventing him from rising from the chair or bed, and not speaking till he is conscious, and as soon as he becomes so to recommence the inhaling as if nothing had happened. A violent patient often becomes perfectly rational in less than two minutes.

Sickness and headache ought not to result from the inhalation of gas, but if the use of it is prolonged, or if the patient is kept for several minutes in a semi-conscious state, breathing a little air with the gas, both these symptoms may occur. The recumbent posture, quiet, and warmth to the feet, constitute all that is likely to be required in the way of treatment.

Ether, Sulphuric Ether, Ethylic Ether, Vinic Ether, or *Oxide of Ethyl*, was first used for anæsthetic purposes in 1846. Before its use was well understood in England chloroform was brought forward as a more convenient agent, and much less unpleasant to the patient. Ether is less liable to become dangerous to life, as it does not under ordinary circumstances depress the action of the heart.

If ether be given from a towel or hollow sponge, the best kind is the *Æther Purus* of the Pharmacopœia, of sp. gr. ·720; but the ether of sp. gr. ·735, which contains a little water, answers very well if the towel or napkin is arranged so as to form a large cone, thus lessening the access of fresh air. The disadvantage of using the latter kind is that the moisture of the patient's breath condenses upon the surface made cold by the evaporating ether, and diminishes its volatility. When pure ether is used, a certain amount of condensed aqueous vapour is taken up before it reaches the density ·735.

In all inhalers where an arrangement is made for preventing the ether from becoming too cold, the washed ether ·735 may be used, and will be found cheaper. Not only is it sold at a lower price, but it is much easier to keep from escaping through cork or stopper.

Although it is not difficult to destroy dogs suddenly with ether, it is believed by many writers on the subject that in man it can only prove fatal by causing asphyxia, and that the signs of this condition are so easily seen and remedied that practically this anæsthetic is quite safe. The writer is not of this opinion, believing that sometimes when narcosis is far advanced, the glottis will allow ether vapour to pass of sufficient strength to stop the heart. Such cases, however, are very rare indeed. Ether is extensively administered by pouring an ounce at a time upon a very large cup-shaped sponge, which, if cold from previous use, is dipped into hot water and squeezed as dry as possible. It is to be expected that the patient will resist breathing when this is held over his face, but after a minute's struggling he becomes unconscious, and easy to manage. Compared with giving ether timidly, so as to let the patient remain delirious for several minutes, this may be a good plan; but there is no necessity for giving the ether so strongly if *we diminish the access of fresh air*. The administration of nitrous oxide from which air is at first excluded, and afterwards admitted very sparingly, has taught us how slight the after-effects are from the asphyxia so induced. Cones of leather or pasteboard lined with felt, and having a small opening at the apex, are better than sponges; but they should be larger. They may be made more effective and economical by placing a thin india-rubber bag over the apex of the cone, so that more of the expired atmosphere may be breathed again.

Morgan's inhaler is very efficient. The ether is poured into a tin chamber as large as a hat, containing sponge. This is covered by a sort of diaphragm, which rises and falls with respiration as the patient breathes into and out of it by means of a tube and face-piece. There are no valves. Anæsthesia results partly from asphyxia, and partly from the action of the ether. The amount breathed depends on its temperature, and on the freedom of respiration. If the respiratory movements are slight, as in young children, or in persons suffering from emphysema, the amount of ether supplied is apt to be too small. Ormsby's inhaler is an improvement upon it, The sponge for ether is contained in a cage near the face-piece.

An excellent inhaler for hospital purposes and for prolonged operations is sold by Mr. Hawkesley. The ether-vessel is kept in a water-bath. There are valves which allow air to pass over the ether, but prevent its return, and the apparatus has an arrangement for lessening the odour of ether in the room, consisting of a tube leading to the floor, which carries off the expired air and ether.

With the view of regulating the strength of the ether vapour, the writer has contrived the following apparatus, which is made by Mayer and Meltzer. It consists of an oval india-rubber bag fifteen inches long, at one end connected with the face-piece, at the other with the ether-vessel. Within the bag is a flexible tube also leading from the face-piece to the ether vessel. By turning a regulator the patient is made to breathe into the bag either directly or indirectly through the tube and ether vessel, or partly one way and partly the other. The more the regulator is turned towards the letter E, the more ether vapour he takes. By turning it back again the amount of vapour is diminished. The ether-vessel contains a reservoir of water, which prevents the ether becoming too cold from evaporation. It is filled with ether up to a mark on the vessel. A thermometer in connection shows the temperature of the ether. The vessel should be just dipped into a basin of warm water and gently rotated till the thermometer reaches from 65° to 70°.

When used this vessel should be suspended by a strap from the neck of the administrator.

At first the regulator allows the passage from the face-piece into the bag to remain open, and the bag should be filled by pressing the face-piece more firmly against the face during expiration than inspiration. By degrees the regulator is turned towards letter E, and thus the way to the inner tube is opened, and the air breathed through it carries ether vapour from the vessel into the distal end of the bag. When the regulator allows half the inspired air to pass through the ether, the vapour is strong enough to induce sleep in two minutes, usually without exciting cough. As the act of swallowing is excited by a smaller quantity of ether than that of coughing, it should be watched for, and the regulator very slightly turned back should it occur.

This same apparatus may be used for giving laughing-gas, all communication with the ether-vessel being cut off by turning a stopcock, and by attaching the tube leading from the gas-bottle to a mount near the bag.

By far the least unpleasant and the quickest way of preparing a patient for a surgical operation is to use gas and ether combined; the change from gas to ether being made by turning the regulator above described as soon as the patient is sufficiently under the influence of gas to disregard the flavour of ether. The supply of gas should be stopped as soon as the ether is introduced; but if subsequently the patient is allowed to become conscious, the gas may be given freely as at first, in order to make him sleep again. The writer finds less sickness and more rapid recovery from the unpleasant taste of ether than when the latter is given alone. The chief difficulty is to prevent the unsteadiness of the patient, resulting from the panting character of the breathing. To lessen this the ether must be given as strong as possible without producing irritation of the throat, and the operator should wait until the influence of the ether has increased to the production of deep stertor. Air being then admitted with every fourth or fifth inspiration, the breathing soon becomes as regular as it is under ether when given in any other way.

On recovering from the inhalation of ether patients are often in a state of intoxication for a period corresponding to the time and extent of the etherization. The eyes should be covered, but the mouth and nose left free; and the room should be kept quiet, with a brisk fire, and the window more or less open. *See* APPENDIX.

Chloroform was introduced by Simpson in 1847. It should not be made from methylated spirit, and, when a drachm is poured upon blotting paper, it should evaporate without leaving an unpleasant odour. It is the most convenient of all anæsthetics, and the most easy to administer. Unfortunately, when given beyond a certain strength, it has a tendency to produce cardiac syncope, and it is not improbable that some persons are particularly liable to be so affected.

Some authorities think it desirable to give alcoholic stimulants before administering chloroform; others partially narcotize the patient with morphia or chloral. No doubt these agents assist the action of the chloroform, but if from any accident an excess of chloroform should be given, they interfere with the means of recovery, and for this reason are not to be recommended. There is less objection to the inhalation of a mixture of chloroform and ether, or of these agents with alcohol; but such mixtures, if kept for some length of time, alter their relative proportions, owing to the escape of the more volatile ingredients. Even the change from the administration of chloroform to that of ether, if made suddenly, is not free from danger, for, when a person is partially under the influence of chloroform, the glottis allows a high percentage of ether to pass; and, if the lung-circulation be slow, as is likely to be the case, the blood may be so highly charged with ether as to depress rather than stimulate the heart.

Chloroform, therefore, should be given gradually. The object should be to keep down the proportion of chloroform-vapour rather than to give abundance of fresh air. In preparing for an operation requiring perfect stillness, six to eight minutes should be allowed for the process. Sponges or lint saturated with chloroform, and held close to the mouth, are dangerous, from the possibility of liquid chloroform falling on the lips or into the mouth. In midwifery practice a piece of linen or blotting paper sprinkled with chloroform and placed at the bottom of a tumbler is a convenient plan of administration, care being taken to prevent any liquid chloroform from settling at the bottom. In general surgery a handkerchief or towel may be folded into a small cone, open at the apex, into which not more than a drachm should be poured at first, and fifteen minims at a time afterwards. A better plan is to roll and tie a piece of lint into a compress the size of a walnut. A drachm to a drachm and a-half of chloroform should be poured upon this, which is to be held about an inch in front of the patient's upper lip, the hand and compress being covered with a towel, which should gradually be drawn over the patient's face. This plan gives considerable command over the supply of chloroform, for, when the chloroform, having cooled by evaporation, is given off too slowly, the vapour can be increased by warming the compress in the palm of the hand. When it is becoming dry it ceases to feel cold, and warning is thus given that fresh chloroform is needed. This should be supplied half a drachm at a time. In doing this the towel should still be left over the face of the patient in order to keep him breathing a slightly chloroformed atmosphere. The movement of swallowing should be looked for, and regarded as evidence that the vapour is stronger than is necessary. If any sound like hiccough indicates laryngeal obstruction, the chloroform and towel should be removed, and, if the sound continue, the chin should be raised as much as possible from the sternum. Laryngeal obstruction arises from two main causes, viz., spasm of the glottis, and falling down of the epiglottis. The first is excited by the pungency of the vapour, and also by reflex action when certain nerves are injured, notably when a ligature is tightened upon a pile. The epiglottis covers the larynx every time we swallow, but the muscles coming from the chin raise it again directly. In deep

narcosis these muscles are sluggish, and cannot act thus if the position of the chin places them at a disadvantage. If raising the chin fail to open the air-passage, the tongue must be pulled forward. In doing this the head should be kept back. Depressing the chin renders a partial obstruction complete. A laryngeal sound indicating obstruction is of little consequence if the pulse is good, since, although the breathing be imperfect, sufficient fresh air continues to be breathed; but if the pulse flags, or if it appears that the amount of chloroform in the air-passages is excessive, not a moment should be lost in seizing the tongue with forceps.

When a patient is delirious and struggling, extra care must be taken that the chloroform be not too strong, because he inhales deeply, carrying the vapour almost to the air-cells of the lungs, and, when he next closes the glottis and strains, the pressure of the air and vapour within the lungs is increased, and the chloroform enters the blood very quickly. The compress should be held at least two inches off the mouth, although the towel may still cover the face. Directly any stertorous noise is heard, a breath or two of fresh air should be allowed, and no more chloroform given till the pulse beats well and the respiration is free.

Skinner's apparatus—a cap of 'domette' flannel stretched over a frame—is a much better apparatus than a towel; but its virtue is simplicity, and it has little pretension to exactitude. Snow's apparatus is very efficient, portable, and economical. The addition of a water-jacket to equalize the temperature was a great improvement; but it should be provided with a thermometer.

The safest and least unpleasant mode of giving chloroform is by means of the apparatus fitted with a large bag of air containing not more than thirty-three minims of chloroform in a thousand inches of air. The apparatus is, however, too complex to be generally adopted, and the writer hopes shortly to be able to introduce a modification of it which will be more easily used. The advantage of more precise measurement of the strength of chloroform-vapour than is afforded by towels or napkins will appear when we consider the several circumstances that alter it when so given.

The *strength of vapour* given off from a known quantity of chloroform is influenced by:—

1. The extent of surface of chloroform.
2. The temperature of the chloroform, which is constantly changing.
3. The temperature of the air of the room, of the patient's face, and of the administrator's hand.
4. The distance at which the chloroform is held from the patient's face.
5. The rapidity of the current of air.
6. The height of the barometer.

Moreover, when the chloroform-mixture is of *known* strength, its effect is increased by high barometrical pressure; by low temperature of the blood; by deep or quick respiration, and especially by muscular efforts when the glottis is closed; and by slow movement of the blood through the lungs.

On the other hand, it is lessened by low barometrical pressure; by high temperature of blood; by superficial or slow respiration; and by rapid circulation through the lungs.

Under ordinary circumstances danger from these causes is easily averted with moderate care, for they do not often concur to produce the same effect; but if a patient, fatigued with struggling, takes a very deep breath just as fresh chloroform has been poured upon the towel, and then closes his glottis and makes another struggle—the barometer being high at the same time—it is evident that blood unduly charged with chloroform will gain access into the coronary arteries, and depress the cardiac ganglia. Death has occurred so rapidly under these circumstances, that it has been thought to be the result of shock from the operation.

Chloroform lessens, if it does not entirely prevent, the shock of an operation, but it is to be feared that if chloroform be given freely for this purpose, a dangerous amount of it will be administered.

If a severe operation is about to be performed, the chloroform should be given in the same gradual manner as in a slighter one, but continued to the point of fixing the pupils and producing stertorous breathing; and, when the chief shock is expected, two or three breaths of pure air should be admitted, so that, if the pulse fail, there may not be an excessive amount of chloroform-vapour in the lungs.

Compounds of Chloroform.—Under this head comes *Bichloride of Methylene*, which contains a variable quantity of chloroform. Its chemical characters and physiological effects are very similar to those of a mixture of chloroform, ether, and alcohol. It narcotizes quickly, but not safely; and, as the amount of chloroform in it is not always uniform, it is better to mix, in small quantities at a time, one part of alcohol, two of chloroform, and three of ether, and to keep the bottle so well corked that the ether is not likely to evaporate and leave chloroform in excess. The word ACE fixes the proportions in one's memory.

A mixture of one part of chloroform with four of ether is convenient for a brief operation, as this produces much less excitement than ether alone. On the whole the writer objects to keeping mixtures of this kind ready-made; and it is probable that the plan of giving at the outset sufficient chloroform to abolish consciousness, and subsequently administering ether, will be found safer than mixing them together in the liquid state.

Ethidene, &c. *See* APPENDIX.

AFTER-TREATMENT.—Quietude or conversation of an encouraging or soothing character is desirable during the half-minute of recovery from gas. The eyes should be covered, unless the view is tranquil as well as pleasant. If gas be given until there are intermissions in the breathing, or its administration continued for several minutes with a small allowance of air, there may be headache and even vomiting: still no other treatment than repose is needed.

After the inhalation of ether a taste will remain, varying with the strength of the vapour, and the duration of the administration. This may be got rid of by washing out the mouth, and gargling with warm fluids; while the vapour remaining about the patient and in the room may

be removed by heating the surface by means of hot bottles, and making a bright fire.

When the system has been long or profoundly under the influence of chloroform or ether, nausea and vomiting are likely to ensue. The writer has not found any remedies more efficient in relieving these symptoms than warmth, fresh air, and abstinence from food. Hot tea and coffee, taken from a feeder without raising the head, and afterwards beef-tea and jelly, are sufficient for twenty-four hours, unless the patient wishes for something solid. The rule then should be to give as little as, or less than, is asked for. Ice has been recommended, and, if it does nothing else, it relieves thirst, and serves to postpone the necessity for giving solids which might prove hurtful.

Treatment of Dangerous Symptoms.—Anæsthetics in excess destroy life by stopping the action of the heart, or the respiration; generally both are affected. When laughing-gas is given to animals till the breathing has ceased, the heart continues to beat long afterwards, and artificial respiration rapidly restores them. Ether-vapour, given almost pure through a tracheal tube, will arrest the action of a dog's heart in sixteen seconds; but if administered as rapidly as possible with a cloth, without opening the trachea, the breathing fails before the heart, and the hæmadynamometer shows adequate pressure in the vessels whilst the breath is gasping, and for several seconds after it has ceased.

With chloroform the hæmadynamometer indicates diminished pressure directly the animal ceases to struggle, and the heart sometimes stops before the breathing. In case alarming symptoms should arise, the first effort should be directed to lessening the amount of the anæsthetic in the lungs, by pressing the trunk with both hands, and squeezing out as much air as possible without causing a shock. If, after this has been done two or three times, the air does not readily re-enter the chest, the obstruction is to be overcome either by lifting the chin or drawing out the tongue, and other artificial movements of the chest must be carried on. (*See* Artificial Respiration.) If pallor be noticed whilst breathing is going on, the recumbent posture and elevation of the feet are immediately required. (*See* Resuscitation.) Nelaton's plan of inverting the body has often been followed by recovery, but, considering the impediment to inspiration from the weight of the abdominal viscera, the writer is of opinion that the pelvis should never be many inches higher than the head. Nitrite of amyl—by reason of its effect in dilating the vessels of the skin—has been recommended, but without careful physiological inquiry, and upon very small clinical experience.

Electricity might be expected to prove the best agent to assist the action of a feeble heart. The writer's experimental observation has not been favourable to its employment; and certainly artificial respiration should not be delayed one moment in order to apply electricity.

Insufflation is not to be depended on. The condition would be rendered worse by distending the stomach, which cannot always be prevented by pressing the larynx against the spine.

Laryngotomy may be required in cases where in spite of throwing the head backward, and removing the chin away from the sternum, air cannot be made to enter the chest.

Hot-water injections may be of use, but there can be no necessity for brandy whilst artificial breathing is being carried on. Afterwards, if swallowing is difficult, brandy may be added to the enema.

Friction of the limbs in the direction of the heart is unnecessary, provided the feet are slightly raised. Where there has been great loss of blood, the limbs should be bandaged firmly from the fingers and toes upward, as in Esmarch's plan for saving the blood of a limb about to be amputated. In warm weather, or if the body is warm, a towel dipped in cold water may be flapped against the chest, but harm would result from cooling the body generally. Bottles of hot water and hot blankets should be applied as soon as the breathing is restored, and a brisk fire should be kept up, in order to favour the ventilation of the chamber. J. T. Clover.

ANALGESIA (ἀ, priv., and ἄλγος, pain).—Absence of sensibility to painful impressions. *See* Sensation, Disorders of.

ANAPHRODISIA (ἀ, priv., and Ἀφροδίτη, Venus). — Absence of sexual appetite. Sometimes used to express Impotence. *See* Sexual Functions, Disorders of.

ANAPHRODISIACS.—Definition.—Medicines which diminish the sexual passion.

Enumeration.—The agents employed as anaphrodisiacs are:—Ice, Cold Baths—local and general; Bromide of Potassium and Ammonium; Iodide of Potassium; Conium; Camphor; Digitalis; Purgatives; Nauseants; and Bleeding.

Action.—The erection which occurs in the genital organs during functional activity is due to dilatation of the arteries in their erectile tissues, and is regulated by a nervous centre situated in the lumbar portion of the spinal cord. From this centre vaso-inhibitory nerves pass to these arteries, and cause them to dilate whenever it is called into action. It may be excited either reflexly by stimulation of the sensory nerves of the genital organs and adjoining parts; or by psychical stimuli passing to it from the brain. Anaphrodisiacs may act by lessening the excitability of the nerves of the genital organs, as the continuous application of cold, and probably, also, bromide of potassium; by diminishing the excitability of the genital centres in the spinal cord and brain, as bromide and iodide of potassium and conium; or by influencing the circulation, as digitalis. There are also adjuvant measures, of a hygienic and moral character, which greatly assist and may even replace anaphrodisiac medicines, such as a meagre diet, especially of a vegetable nature, the avoidance of stimulants, and the pursuit of active mental and bodily exercise. Everything tending to stimulate the genital organs, or to increase the flow of blood to them or to the lumbar portion of the spinal cord, should be avoided, such as warm and heavy clothing, or pads about the hips or loins; and a hard mattress should be used in place of a feather-bed. Everything likely to arouse the passions, such as certain

novels, pictures, theatrical representations, &c. should also be shunned.

Uses.—Anaphrodisiacs are employed to lessen the sexual passions when these are abnormally excited in satyriasis, nymphomania, and allied conditions. As such excitement may sometimes depend on local irritation of the genitals, in consequence of prurigo of the external organs, excoriations of the os uteri, or balanitis; or on the presence of worms in the rectum or vagina; these sources of excitement should be looked for, and, if present, should be subjected to appropriate treatment. T. Lauder Brunton.

ANASARCA (*ἀνὰ*, through, and *σάρξ*, the flesh).—An effusion of serous fluid into the subcutaneous connective tissues, not limited to a particular locality, but becoming more or less diffused. *See* Dropsy.

ANCHYLOSIS (*ἀγκύλος*, crooked).—Marked stiffness or absolute fixation of a joint, which may be due to various morbid conditions of the structures entering into its formation. *See* Joints, Diseases of.

ANCHYLOSTOMA (*ἀγκύλος*, crooked, and *στόμα*, a mouth).—A genus of nematoid worms. *See* Sclerostoma.

ANEURISM (*ἀνευρύνω*, I dilate.)—Definition.—Aneurism is a local dilatation of an artery, leading to the formation of a tumour which contains blood, and the walls of which are composed either of the tissues of the vessel, or those which form its sheath or immediately surround it. Therefore every aneurism, properly so called, consists of two parts—a *sac* and its *contents*.

Classification.—Aneurisms are usually divided, according to the varying composition of the sac, into the following varieties:—

1. *True* aneurism, in which all the three coats of the artery form the sac or a portion of the sac. This variety is rare: at least it is so rarely possible to trace all the coats of the artery over any part of the sac beyond its orifice, that some pathologists deny the existence of this so-called 'true' form of aneurism, and most admit its existence in the aorta only.

2. *False* aneurism, in which the sac is formed by one only of the coats of the artery. This is almost always the external coat; but a subvariety has been proved to exist as a consequence of wound of the outer part of the vessel, and is believed by some to take place spontaneously, in which the inner coat, or the inner and part of the middle coat, is dilated, pushed through the outer coat, and forms the sac. This is called *hernial false aneurism*.

3. *Diffused* or *Consecutive* aneurism. Here the sac is formed of the sheath, cellular tissue, or other structures around the artery, which are matted together into the form of a membrane. The name 'diffused' is applied to this form of aneurism to express the fact that the blood is at first diffused amongst the tissues in consequence of the rupture or division, whether from injury or disease, of all the coats of the vessel, either in a part or the whole of its circumference; but it is not a good term, since, as soon as the aneurismal sac is formed, the blood is diffused no longer, but, on the contrary, is encysted in the newly formed sac. So that the other term, 'consecutive,' seems a better one, expressing, as it does, the important fact that the formation of such aneurisms is always consecutive on a rupture, partial or entire, of the artery.

4. *Dissecting* aneurism is seen only within the trunk of the body, and always involving the aorta—although it may spread from the main artery down to its branches. In this form the internal and middle coats have given way, or cracked; and the blood has forced its way, usually into the substance of the middle coat, sometimes perhaps between the middle and outer coats, distending the external portion of the vessel into a kind of aneurism.

This is the nomenclature still in common use; but as the first and second varieties are practically indistinguishable during life, and the first, though called the 'true' form of aneurism, is very rare, it would be better to include both under the common name 'true' aneurism, and apply the term 'false' to the third or 'consecutive' form.

5. Besides these, which are all forms of pure arterial aneurism, there are aneurisms in which the vein and artery are simultaneously involved, and which are therefore called *Arterio-venous*, which will be afterwards spoken of; and tumours having a certain analogy to aneurism, which are formed of dilated and tortuous arteries—*Cirsoid* and *Anastomotic* aneurisms.

Other classifications of great importance are, according to the cause of the disease, into *Spontaneous* and *Traumatic*; or, according to the shape of the tumour, into *Fusiform* and *Sacculated*. In *fusiform* aneurism there is a dilated tract of artery, often of considerable length, from either end of which springs the vessel of its natural calibre. *Sacculated* aneurism springs like a bud from one side of the vessel, and the artery is often buried for some distance in the wall of the aneurism; but there are many sacculated aneurisms which approach in shape to the fusiform, the vessel being dilated for some part of its extent, so that its two openings lie at different parts, and sometimes on different aspects of the sac.

Ætiology and Pathology.—The proximate cause of spontaneous aneurism appears to be usually a loss of the elasticity of the wall of the artery, whereby it loses its power of resilience after having been dilated by the force of the circulation. This loss of elasticity is commonly caused by atheroma or else by partial calcification of the wall of the artery. In the latter case the blood often forces its way through the entire arterial wall, and an aneurism of the consecutive variety forms,[1] or the external part of the artery is dissected off, and a dissecting aneurism results. Inflammatory softening of the artery, without the presence of any definite atheromatous deposit is looked upon by many writers of credit, such as Wilks and Moxon, as a common cause of aneurism. Such low inflammation may have its origin possibly in rheumatism—and, as a matter of fact aneurism is often preceded by acute rheumatism; more certainly in violent strain, or

[1] Sometimes, however, the bleeding will go on without the formation of any aneurismal sac, and lead to the loss of life or limb.

in mechanical violence. Anything else which weakens the arterial wall, such as the exposure of the vessel in an abscess, is looked on as a cause of aneurism. The yielding of a weakened arterial wall is doubtless accelerated by irregularities of the circulation. The influence of syphilis and of intemperance in causing aneurism is widely believed, though perhaps as yet neither fact is absolutely established: the latter, at any rate, is rendered very probable from the consideration that chronic alcoholism tends to impair the nutrition of all the tissues, including the arteries, and is accompanied by a constantly irritable condition of the circulation. That syphilis may cause a fibroid degeneration of the vessels must also be allowed to be at least possible, and that it does so is the opinion of many eminent pathologists. If so, the transition to aneurism is natural, if not inevitable. Another proved cause of aneurism is embolism, or the obstruction of a diseased artery by a fibrinous plug, which has been known to be followed by the dilatation of the artery immediately above the plug, just as in very rare cases the ligature of a healthy vessel has given rise to the formation of aneurism above the tied part.[1] Violence is a very frequent cause of aneurism, even in cases which are not technically denominated 'traumatic.' The latter term is generally restricted to cases in which the vessel is wounded by a cut, or is known to be ruptured, and the aneurism makes its appearance at once; and in these cases the aneurism is of the 'diffused' or 'consecutive' variety. But there are, no doubt, many cases in which the artery is partially torn, and the walls, being thus weakened, afterwards slowly yield at the injured spot. This fact is illustrated by the well-known experiment of Richerand, designed to explain the frequency of popliteal aneurism. The experiment consists in hyperextension of the knee in the dead subject. If this be carried on forcibly till the ligaments are heard to crack, it will usually be found that the two inner coats of the popliteal artery are torn.

All these causes of aneurism act much more powerfully in later life than in childhood, and many are unknown in early years. Aneurism, therefore, is very rare in children. In cases where the arterial system is extensively affected with atheroma, a great number of aneurisms may be found in the same person, or another may form after the cure of the first. To such cases the term 'aneurismal diathesis' has been applied. This fact shows the great importance, in all cases of spontaneous aneurism, of examining the whole body to detect disease of the heart or any second aneurism which may exist.

Almost all aneurisms contain more or less *clot*, and much of this clot is usually of the laminated variety, consisting almost entirely of fibrine mixed with more or less of the blood-corpuscles. These laminated coagula adhere very firmly to the interior of the sac; they are arranged concentrically like the coats of an onion; and usually lose their colour in proportion to their remoteness from the blood which still circulates through the sac. Their deposition depends in a great measure on the presence of rough projections from the wall or mouth of the sac, and on the shape of the aneurism. When the latter is purely cylindrical, much less coagulum, possibly none, will be found in it. When the tumour stands well away from the artery, so that the force of the circulation is much broken, the formation of coagula is greatly favoured. The deposition of such firm coagula must be looked on as the commencement of spontaneous cure, and at any rate defends the patient from the risks of rupture, or of renewed growth of the tumour at the parts which are so lined.

Symptoms.—The symptoms of arterial aneurism are as follows:—There is a pulsating tumour, which is situated in the course of one of the arteries, and which cannot be drawn away from the vessel. The pulsation is equable and expansile, that is, it not only causes an up-and-down movement of the tumour, for such a movement may be communicated to any tumour by a large vessel lying in contact with it, but also expands the tumour laterally and in all other directions. The pulsation is in most cases accompanied by a *bruit* or blowing sound, heard on auscultation, which can be tolerably well imitated by the lips, and which is synchronous with the pulsation. Pressure on the artery above suspends both the pulsation and the bruit. Sometimes it may be noticed that the pulse below is retarded, that is, that it reaches the finger later than in the corresponding vessel on the other side. Besides these, which are the main signs of aneurism, there are others, which are of less constant occurrence or of subordinate importance. Thus, on compression of the artery above, the tumour will empty itself more or less completely, and the greater or less change of size under these conditions is a useful test of the proportion of fluid and solid in the sac. Sometimes pressure on the artery beyond the tumour may cause an increase in its size. The pulse below the tumour is often found to differ strikingly from that on the sound side. There are many and various symptoms due to the pressure of the aneurism on neighbouring veins, nerves, bones, and viscera—symptoms which are of subordinate importance in a diagnostic point of view in the case of external aneurism, but are often of the greatest value in thoracic and abdominal aneurisms. Thus dyspnœa and ringing cough from pressure on the trachea, spasm or paralysis of the vocal cords from pressure on the recurrent laryngeal nerve, pain in the back from pressure on the vertebræ, or neuralgic pains from pressure on the nerves at the root of the neck, are well-known symptoms of aortic aneurism; and, similarly, pain in the leg from pressure on the popliteal nerve, and œdema from compression of the vein are frequent symptoms of popliteal aneurism.

Diagnosis.—The affections which are usually confounded with aneurism are tumours of various kinds lying upon arteries, abscesses, and cancerous tumours which have large vascular spaces in their interior, and therefore pulsate. The tumours which receive pulsation from arteries against which they lie are of various kinds; cysts and enlarged glands in the popliteal space, and enlargements of the thyroid body pressing

[1] For cases of this nature see *System of Surgery*, 2nd edit. vol. iii. p. 422.

on the carotid or innominate artery, are the most familiar examples. The diagnosis is usually easy. They have commonly little or no bruit, though in some cases a dull thud is produced by their pressure on the artery; they have not the expansile pulsation of aneurism; they present no change in size or form when the circulation is stopped; and they can usually be drawn away from the artery sufficiently far to lose their pulsation. An abscess has been often mistaken for aneurism, but the mistake has generally proceeded from a neglect of auscultation.[1] There are a very few cases in which aneurisms have lost their pulsation in consequence of the rupture of the sac, and in which no bruit may be audible,[2] and such tumours can hardly be diagnosed from abscess except by an exploratory puncture, which under these circumstances is justifiable; these cases are, however, extremely rare. The disease most commonly mistaken for aneurism is pulsating cancer, and the resemblance has been sometimes so striking as to deceive the best surgeons, even after the fullest possible investigation of the case. These pulsating cancers almost always grow from the bones;[3] and the neighbouring bone can generally be felt to be enlarged, which is rare in aneurism. They have not usually the well-marked bruit of an aneurism, nor is the bruit universal; the pulsation also is more indistinct, and not so expansile as in aneurism; and the growth of the tumour is more rapid.

Course and Terminations. — Aneurism is generally a fatal disease if left to itself. The sac enlarges; parts of it give way, either by a process of inflammatory softening or by rupture; or it produces fatal pressure on the surrounding parts; or the whole tumour suppurates, and the patient dies of fever, of pyæmia, or of hæmorrhage. But to this general statement, independent altogether of what the effects of any special treatment may be, there are numerous exceptions. In some cases, and especially in the fusiform kind of aneurism, the tumour, after having attained a certain size, remains stationary, and this stationary condition is sometimes produced by a deposit of coagulum lining the sac, and leaving a canal through which the blood-stream passes, as through the normal artery. In these cases, however, the symptoms persist, but there are others in which a complete spontaneous cure is obtained, and this may happen in various ways.

Spontaneous Cure.—The first, and probably the most usual method of spontaneous cure is by the gradual diminution of the circulation through the tumour, and the gradual filling of the sac by successive layers of fibrinous coagulum. The second is by impaction of clot in the mouth of the aneurism, whereby in some cases possibly the sac of the aneurism is cut off from the blood-stream, and its contents brought to coagulate. In other cases, where more than one artery opens out of the sac, the impaction of clot in one of the distal arteries leads to consolidation of all that part of the tumour through which the circulation used to pass into the obstructed vessel, and thus a practical cure is sometimes effected,[1] *i.e.* the symptoms are cured and the disease arrested, though the whole sac is not consolidated. The third method of spontaneous cure is by inflammation of the tumour. This is usually accompanied by suppuration of the sac and evacuation of all the contents of the aneurism, the accompanying inflammation closing the mouths of the arteries which open out of it. If the arteries are not so closed, death from hæmorrhage will occur. It seems possible that inflammation of the sac and the cellular membrane around it may sometimes produce coagulation within the aneurism without any suppuration. A fourth way in which coagulation of an aneurism has been known to be caused is by retardation of the circulation or impaction of clot, caused by another aneurism above; and there is an old idea, which can hardly yet be said to be exploded, that an aneurismal sac may by its growth compress the artery, and so lead to its own coagulation. This, however, if it ever happens, is purely exceptional.

Rupture.—The rupture of an aneurism may take place either through the skin, in which case the hæmorrhage is usually, but not always, fatal at once;[2] or into one of the cavities of the body, when death generally occurs immediately, if the rupture is into a serous cavity, and after one or two attacks of hæmorrhage if a mucous membrane has been involved; or lastly into the cellular tissue of a part. This event is marked by the cessation of the pulsation; the sudden swelling, accompanied with ecchymosis if the blood is effused subcutaneously; and the abrupt fall of temperature below the aneurism. A sensation of pain, or of 'something giving way,' is often experienced. Stethoscopic examination will probably detect a bruit.

Treatment.—*a.* Medical.—The methods of treatment of aneurism are very numerous, and it would be impossible in a summary of this kind to discuss fully all the indications for each. In the first place, those aneurisms which are inaccessible to any local treatment, or in which local treatment would involve great danger, are treated *medically*, that is by regimen, diet, and medicine, by which it is hoped that gradual coagulation will be promoted in the contents of the tumour, and thus a complete or a partial cure will be brought about, as in the natural process above spoken of. The method of Valsalva, of which the main features were starving and excessive bleeding, and which therefore produced considerable and often dangerous irregularity of the heart's action, is now given up in favour of the opposite plan introduced by Bellingham and modified by Mr. Jolliffe Tufnell,[3] in which, by complete rest and restricted but nutritious diet, the absolute regularity of the heart's action is secured, and at a rate below that of health, both

[1] See a paper by the author in *St. George's Hospital Reports*, vol. vii. pp. 175 *et seq.*

[2] See a case under the care of the writer, reported in the same paper, p. 190.

[3] In one case under the care of the writer the disease was unconnected with the bones, and affected the kidney only.—*Pathological Transactions*, vol. xxiv. p. 149.

[1] See a case of innominate aneurism with remarks in the *Lancet*, June 15, 1872, p. 818.

[2] Instances of successful ligature of the artery above after bleeding from ruptured aneurism are on record. See a case in the *Lancet*, 1851, vol. ii. p. 30, in which the femoral artery was successfully tied after the bursting of a femoral aneurism through the skin.

[3] *The Successful Treatment of Internal Aneurism*, 2nd edit. 1875.

as to rapidity and force. Mr. Tufnell has given some interesting and conclusive examples of the complete cure of abdominal aneurisms thus accomplished, verified by dissection; and one, at least, in which an aneurism of the arch of the aorta was in all probability entirely consolidated, though this fact was not verified by dissection. At any rate the patient was permanently restored to health. In this method of treatment drugs are only employed when necessary (as narcotics, laxatives, and tonics often are) to ensure the regularity of the functions, to control irritability, or to support the general health. The drugs which have been recommended as producing a direct effect on aneurism by promoting the coagulation of blood in the sac, such as acetate of lead and iodide of potassium, do not, in the writer's opinion, produce any such effect, nor in fact any specific effect on the disease whatever. He has often seen a certain amount of improvement under the use of these drugs, but not, he thinks, more than the regimen and diet used at the same time would account for. Other drugs, as aconite and digitalis, are recommended in order to steady and reduce the heart's action, and the latter especially is sometimes a useful adjuvant, if employed with caution, to the treatment by restricted diet and rest. The rest is *total*, the patient never leaving his bed, nor ever rising from it, or changing his position more than by occasionally turning on his side; the bowels are so regulated as to avoid both constipation and looseness; and the diet is restricted to about 10 oz. of solid food, of which one half is meat or fish, and 8 oz. of fluid (comprising 2 or 3 oz. of light wine if necessary), per diem. The period may be extended indefinitely, so long as improvement continues; but in all cases the patient and his friends should be prepared for a confinement of not less than three months. *See* ABDOMINAL ANEURISM; and AORTA, Diseases of (*Aneurism*).

b, SURGICAL.—Most aneurisms which occupy an external position, and are therefore amenable to surgical treatment, are curable, when the degeneration of the vascular system is not too extensive, by mechanical means. Of these the chief and by far the most successful are either the *ligature of the artery*, whether in the sac, above it, or in some special cases below; or *compression*, applied either to the artery above the aneurism, or to the tumour itself, or simultaneously in both situations, and either by the pressure of an instrument, of the fingers, or of Esmarch's bandage. But as these methods of treatment belong exclusively to the province of surgery, it is thought better in a work of this kind merely to name them, and to refer the reader to the standard works on surgery for their description.

The other methods of surgical treatment are far less successful than the above, and have the great drawback of being addressed exclusively to the contents of the sac; while in the treatment by the ligature and by compression the resilient power of the sac, and its consequent reaction on the blood which it contains, no doubt play a great part in the cure. The methods now to be mentioned, on the contrary, as far as they act on the sac at all, rather tend to contuse or to inflame it.

Galvanopuncture.—The first is galvanopuncture, in which a current of electricity of low tension, long continued, is passed through the blood in the sac, decomposing it, and causing its coagulation. Needles are plunged into the sac, and are then connected with the battery, and the action is continued until the reduction in the pulsation and the flattening of the tumour show that the blood has been partly coagulated. Authorities differ as to the details of the method. Some apply first the positive and then the negative pole to each needle, others the negative pole only, the positive being brought in contact with the neighbouring skin, while some on the contrary use the positive pole only. It will be found on experiment that a certain amount of coagulation takes place around both poles, the clot round the positive pole being smaller but firmer than that round the negative. The object of the operation is to fill the sac as much as possible with coagulum which shall gradually harden, and shall attract to itself fresh coagula. The dangers of the proceeding are those of inflammation of the sac, or of the cellular tissue around it; of suppuration within the tumour; or of sloughing of the punctures and hæmorrhage: and it must be allowed that the effects of galvanopuncture are very uncertain, both as to the amount and firmness of the coagulum produced. Still there is satisfactory evidence of benefit in many cases, and of a cure in a few. The danger of inflaming or cauterising the sac or the tissues around may be in some measure obviated by coating the needles with vulcanite, as recommended by Dr. John Duncan of Edinburgh. For a very clear exposition of the details of this method, as well as for statements regarding the success which has attended electrolysis hitherto, the reader is referred to a lecture by this gentleman, reported in the *British Medical Journal*, May 20, 1876. The writer thinks himself justified in adding that electrolysis should be restricted to cases of thoracic, subclavian, or abdominal aneurism, which cannot be cured by medical means, and in which rupture seems to be imminent, while the situation of the tumour forbids the application of pressure.

Coagulating Injections. — Another method of producing coagulation of the blood in the sac is by the use of coagulating injections. Other fluids have been employed, but the only one in general use now is the perchloride of iron. The circulation is to be suspended by pressure on the artery above, before the injection is made and for some time afterwards. The method is a very dangerous one for large aneurisms, on account of the risks of embolism, sloughing, and inflammation, but it may be used with success in small cirsoid and anastomotic aneurisms, and also in varicose aneurism.

Introduction of foreign bodies.— Aneurisms have also been treated by the introduction of foreign bodies into the sac, with the view of producing coagulation of the blood upon the foreign substance, such as fine wire, carbolised catgut, and horsehair; but no case of cure has hitherto been reported.

Manipulation.— Finally, aneurisms may be treated by manipulation. The object of this treatment is either to detach a portion of coagu-

lum from the wall of the aneurism, which may be carried into the mouth of the sac or the distal artery, and so effect a cure as in our second mode of spontaneous cure, or at any rate so to disturb and break up the clot, that its detached laminæ may form nuclei for further coagulation. With this view the aneurismal tumour is grasped between the two hands to squeeze all the fluid blood out of it, and one wall rubbed against the other till 'a friction of surfaces is felt within the flattened mass.'[1] The proceeding is obviously a very dangerous and uncertain one, but some indubitable cures have been thus effected.

Arteriovenous Aneurisms.—A few words must be added with respect to the rarer forms of aneurism. Arteriovenous aneurisms are generally, but not always, traumatic, and are divided into two chief forms:—1. *Varicose aneurism*, in which there is a small aneurismal tumour communicating both with the artery and with a vein which is always varicose; and 2. *Aneurismal varix*, in which the opening between the two vessels is direct without any tumour interposed; the vein pulsates as well as being varicose, and the temperature of the limb and nutrition of the skin and hair are increased. In all forms of arteriovenous aneurism the artery after a time becomes thin and much dilated. The signs of arteriovenous differ from those of arterial aneurism mainly in this—that besides the intermittent blowing murmur caused by the arterial current, there is a continuous purring or rasping bruit due to the venous current; and that besides the intermittent pulsation there is a continuous thrill. Varicose aneurism may be cured by digital pressure applied directly to the venous orifice, and indirectly to the artery above at the same time; or the old operation may be performed, the clots being turned out of the sac and the artery tied above and below, the vein being of course laid open and secured either by ligature or pressure; or the artery may be tied above and below without opening the sac. Electropuncture and coagulating injections have also been used with success. Aneurismal varix does not usually require or admit of surgical treatment. If it does, the ligature of both parts of the artery is the only measure that can be adopted, on the failure of compression.

Cirsoid and Anastomotic Aneurisms.—*Cirsoid aneurism*, or *arterial varix*, is a tumour formed by the coils of a single dilated and elongated artery;[2] while *aneurism by anastomosis* is a tumour formed by the coils of numerous dilated and elongated arteries, with the dilated capillaries and veins which communicate with those arteries. It is often difficult to distinguish these two forms of arterial disease from each other. Aneurism by anastomosis frequently originates congenitally as one of the forms of nævus. The usual situation of these tumours is on the scalp. They have often a peculiar continuous buzzing or rushing murmur, which is propagated over the whole head, and much disturbs the patient's rest; while they are liable to ulcerate and to become the source of serious and even fatal hæmorrhage. Some cases of spontaneous cure are on record. Very numerous methods of treatment have been employed, of which the writer can only mention those which are most generally useful. When feasible, the total removal of the tumour with the knife is certain to effect a radical cure, but this operation is often too dangerous to be attempted. The entire removal by ligature is still more rarely practicable. The galvanic cautery is often successful; the incandescent wire being drawn through the mass in various directions divides it into portions, and obliterates the vessels by producing cicatrices at the parts cauterised. Setons have also been used with success, when combined with the ligature of the trunk-artery; and the ligature of the artery alone has been said to be followed by success, but certainly is generally unsuccessful. Finally, coagulating injections and galvanopuncture have both effected a certain number of cures.

T. Holmes.

ANGEIECTASIA (ἀγγεῖον, a vessel, and ἔκτασις, extension).—Extension or hypertrophy of the capillaries and minute vessels of the surfaces of the body, especially the skin; hence *angeiectasia capillaris*, a term applicable to several forms of vascular nævus.

ANGEIOLEUCITIS (ἀγγεῖον, a vessel, and λευκὸς, white).—Inflammation of lymphatic vessels. *See* Lymphatic System, Diseases of.

ANGINA (ἄγχω, I seize by the throat, strangle, or choke).—Synon.:—Fr. *angine*; Ger. *die Bräune*.

The term *angina* was originally applied by Latin writers on Physic, and is still much used on the Continent, to indicate a condition in which difficulty of breathing and of swallowing exist either together or separately, caused by disease situated between the mouth and the lungs, or between the mouth and the stomach. By a special affix to the original term, significative of the seat or the nature of the disease, several varieties of morbid states are known and described, for example:—*angina parotidea*, or mumps; *angina tonsillaris*, or quinsy; *angina laryngea*, or laryngitis; *angina pectoris*, or breast-pang; *angina maligna*, or malignant sore throat; *angina membranosa*, or croup.

These and numerous other diseases, differing essentially in their nature and pathological relations, and having nothing in common but certain difficulties in breathing or swallowing, are thus classed under the word *angina*. Such a classification is open to several objections, and has nothing to recommend it. With the exception, therefore, of *angina pectoris*, which has a special and familiar signification, the various diseases occasionally recognised by the term angina will be found described under the names by which they are generally known in this country. *See* also Cynanche.

R. Quain, M.D.

ANGINA PECTORIS.—Synon.: Syncope Anginosa; Angor Pectoris; Suffocative Breast-pang. Fr. *Angine de poitrine*; Ger. *Brust-bräune*.

Definition.—An affection of the chest, characterised by severe pain, faintness, and anxiety, occurring in paroxysms: connected with disorders of the pneumogastric and sympathetic nerves and

[1] Sir W. Fergusson, *Med. Chir. Trans.* xl. 8.

[2] See the figure on p. 534, vol. iii. of the *System of Surgery*, 2nd edition.

their branches; and frequently associated with organic disease of the heart.

Description.—An attack of angina pectoris commences suddenly with pain in the region of the heart, generally on a level with the lower end of the sternum. The pain is severe, and of a grasping, crushing, or stabbing character; it extends sometimes across the chest, but more frequently backwards to the scapula, and upwards to the left shoulder and arm. The pain is accompanied by a distressing sense of sinking, of faintness, or of impending death. The action of the heart is generally irregular. The pulse at the wrist corresponds; but in some well-marked cases it is regular, tense, and resisting. A fear of aggravating the pain prevents the patient from breathing, though the respiratory function may not be really interfered with. The expression is anxious, the face is pallid, and the lips are more or less livid. The whole surface of the body is pale, cold, and covered with a clammy sweat. Flatulence is often present; urine in some cases is passed at short intervals, and generally in abundance. The sense of faintness causes the patient to seek support, and he rests on any object by which this may be obtained. The attack having lasted for a variable time—from a few minutes to one or two hours—comes to an end, either by a sudden cessation of the more urgent symptoms, or by their gradual disappearance. The pallor and coldness of the surface are replaced by a uniform glow—the face may even flush, the pulse becoming soft and full, and there is a general feeling of relief; a sense of numbness or tingling along the course of the nerves derived from the brachial and cervical plexuses of the affected side occasionally remains. An attack of angina pectoris frequently comes on during sleep; but it may be induced by emotion or by physical exertion, especially by walking up an ascent, or by exposure to cold air or wind. An attack of this kind may occur but once and end fatally; or it may recur after an interval of hours, days, or weeks, and be thus continued; or there may be an interval even of years. These and other modifications of the disease will be again referred to.

Pathology.—The nature of the aggregate of the symptoms or phenomena comprised under the name *angina pectoris*, cannot be understood without a clear apprehension of the relations of the nerve-elements of the organs and regions that seem to be involved in the affection. It will be well briefly to summarise them.

The nerves chiefly involved are the pneumogastric and the sympathetic, and their branches, which nerves, it should here be stated, are connected with each other at their origin in the medulla oblongata, in their course, and in their distribution to the ganglia and structures of the heart. They also communicate with certain of the cerebral nerves, and with the cervical and brachial plexuses, which supply part of the head and neck, the arms, the diaphragm, and the chest-walls. Their connections with the heart are very extensive. This organ is supplied by the cardiac ganglia and the branches derived from them, which are in relation with, and, in fact, constitute part of the cardiac plexus formed by the interlacement of branches from the pneumogastric and the sympathetic nerves. The pneumogastric supplies the superior cardiac nerve and apparently the inferior cardiac nerve (which, however, is derived from the spinal accessory, and is merely distributed with the pneumogastric); the sympathetic contributes several branches through the cervical ganglia. Branches of both pneumogastric and sympathetic nerves are distributed to the respiratory passages, the lungs, stomach, intestines, liver, and other abdominal viscera.

The connection of the pneumogastric and sympathetic nerves in the medulla, to which allusion has been made, occurs at the cardiac and vaso-motor centres; and consequently these nerves, and the heart (which they supply) are thus brought into relation with the vaso-motor nerves throughout the body, and with all the systemic blood-vessels; they are also in relation with the other important centres in the neighbourhood; and with the cerebrum itself, more especially that part of it associated with the emotions.

Such being the distribution and the relation of the nerves connected with the heart and surrounding parts, we learn, in reference to their functions, that the movements of the heart are maintained by its ganglia, but that these movements may be accelerated by the action of the sympathetic, whilst they are controlled and may be even arrested by that of the inferior cardiac branch from the pneumogastric.

The superior cardiac branch of the pneumogastric has to do with the specific function of conveying impressions contripetally from the heart to the medulla, whence these impressions may be reflected through the inferior cardiac nerve to the heart, controlling for a time its movements; and also reflected through the vaso-motor centre and vaso-motor nerves, to the general circulation. By means of this latter functional relation, relaxation of the arteries, especially those of the abdomen through the splanchnic nerves is accomplished, and the heart is relieved of pressure.

With regard to other functions of the cardiac nerves, it is believed that such common sensibility as the heart possesses is more especially connected with the superior cardiac branch of the pneumogastric. Numerous communications exist between this nerve and the ordinary spinal nerves; and it must also be remembered in reference to the sites of pain in angina, that nerves may be rendered sensitive by disease which are not sensitive in health.

Lastly, it is to be noted that the pneumogastric and sympathetic nerves, as well as the heart and blood-vessels, whose functions they regulate, possess the extensive connections above mentioned with the abdominal and thoracic viscera, and thus they not only influence but are influenced by the conditions of the lungs, liver, stomach, kidneys, and other organs.

Keeping in mind this distribution of nerves and their functions, we can recognise how the movements of the heart may be affected, whether in the direction of acceleration, retardation, or even arrest. We can further understand how painful impressions originating in the cardiac nerves may be propagated so as to be referred

to the associated sensory nerves and their branches; and how relations may be established with the vaso-motor system and the circulation generally. Thus the vessels throughout the body may be acted upon, producing coldness and pallor of surface from the abnormal filling of the abdominal at the expense of the superficial vessels, a condition which seems to be the cause of the diminished arterial tension noticed in these cases. We can also comprehend how morbid impressions made either on these nerves, in their distribution to the abdominal viscera or the heart, or on the peripheral distribution of the vaso-motor nerves at the surface of the body, may, passing centripetally, admit of reflex impressions and reflex actions, which in some cases may be provocative of the symptoms of this disease: also how direct impressions made on the nerves themselves in their course, or at the vaso-motor centre, or through the cerebral emotive centres, may each give rise to the phenomena which represent the symptoms constituting angina pectoris.

Pathology of Uncomplicated Angina Pectoris.—That this disease is dependent on an affection of nerves may be held to be demonstrated by the paroxysmal character of the attack; by its sudden access and sudden departure; by the nature of the causes that promote it, whether they be mental emotion or direct or reflected irritation; by the course and character of the pain, and by the fact that in severe—even fatal—instances of angina, there is often an absence of any tangible or evident organic local disease.

The morbid state affecting the nerves may be situated in the medulla; or it may be in the course of these nerves, or in their branches; or in the cardiac ganglia themselves. It may be the result of congestion or inflammation of the nerve, such as occurs in the lithic acid or gouty diathesis; or of other textural changes, such as connective-tissue growth, involving the nerve-fibres and ganglia. It may be produced by emotions acting centrifugally; or by irritation acting centripetally, reflected, as we have just said, from impressions made on the peripheral extremities of nerves. Thus acidity of the stomach distended by flatus, the result of indigestion, often gives rise to symptoms which very closely resemble, if they do not constitute, an attack of angina. The like effect has been produced by irritation reflected from the fifth nerve, as, for example, in pivoting teeth; by such irritation of the surface of the skin as results from severe herpes; by cold, or by exposure to wind. But the most frequent source of the symptoms of angina caused by reflex action is to be found in those organic affections of the heart which will be described in the next section.

Whatever the nature of the irritation or of the exciting cause, the symptoms will, in some measure, bear a relation to the nerves affected. Thus, if the sensory branches connected with the spinal nerves suffer, we shall probably have pain more severe and more diffused: whereas if the branches more immediately supplying the heart are affected, we shall have the action of that organ more or less disturbed, accelerated or depressed. And so with the branches of other nerves, more especially of those connected with the vaso-motor system, or with the lungs and abdominal viscera, modifications of symptoms are produced which it is needless to describe at this point in detail.

Pathology of Angina Pectoris complicated with Organic Disease of the Heart and Vessels.—The striking character of the symptoms of angina pectoris has led pathologists to connect the heart with the disease, and to investigate its condition accordingly. Such researches have established the fact already mentioned, that angina may exist without any discoverable disease in the heart or its appendages. On the other hand, in the great majority of cases various forms of structural disease of the heart and aorta have been observed; for example atheromatous or calcareous degeneration in the coronary arteries, in the valves, or in the aorta; dilatation of the cavities of the heart, or of the aorta; accumulation of fat in the cardiac walls; and lastly, and probably the most important change of all, fatty degeneration of the muscular tissue. A knowledge of this lesion is of comparatively recent date; it is constantly associated with the calcareous and atheromatous diseases described above, and which alone attracted the notice of older observers. Nay more, this lesion of the walls of the heart is in itself a frequent and sufficient cause of one of the most prominent symptoms of angina pectoris—faintness. This condition has been elsewhere described by the present writer (*Medical and Chirurgical Society's Transactions*, vol. xxxiii.) under the name of *Syncope Lethalis* or fatal-faintness—a designation analogous to that given by Parry to angina pectoris, which he called *Syncope Anginosa*.

Ætiology.—When treating of the pathology of angina pectoris we have already discussed the conditions under which it occurs. We have endeavoured to show that the disease consists in a lesion of certain nerves, associated with various morbid conditions. In seeking to indicate the *predisposing causes* of these conditions, we have to point out (1) the existence of a peculiar state of the nervous system, which may be described as an undue susceptibility to impressions. What that state is we know not. It would seem to be often hereditary, and to be found in those temperaments in which there is a high development of the nervous element, associated with certain habits of life, such as sedentary employments, high living, and so on. Thus it is that this disease has been the cause of the death of many men who, by their intellectual parts, have left their mark on history. It is merely necessary to mention, as instances, Lord Clarendon, John Hunter, Dr. Arnold. (2) The influence of age is conspicuous; the disease is rare before puberty; and the writer's researches show that quite eighty per cent. of cases occur after forty years of age. (3) Sex also displays a marked influence on the disease; it is comparatively rare amongst women, a statement by the late Sir John Forbes showing that out of 49 fatal cases, only 2 occurred in females; and 4 out of 15 non-fatal cases—facts entirely corresponding with the writer's experience. (4) The peculiar diathesis which gives rise to neuralgia of various parts, and that in

which lithic acid predominates in the system, would seem to be in many cases an efficient cause of the symptoms of angina.

The *exciting causes* of angina pectoris are (1) Those that affect the nerve-textures themselves. (2) The condition to which we have referred, in which organic disease of the heart exists. (3) Mental emotion, especially anger or nervous shock. (4) Irritation propagated centripetally from the surface, as by the branches of the fifth nerve; through the brachial plexus; through the sympathetic and pneumogastric nerves distributed to the abdominal viscera. (5) Cold applied to the surface, and especially cold winds. (6) Physical exertion, or any other agency by which the circulation is quickened. (7) Depressing agents, such as excessive tobacco-smoking, malaria, &c.

Anatomical Characters.—Beyond the conditions indicated under the head of Pathology, there is little to be said on the morbid anatomy of angina pectoris. These several conditions, and the symptoms of angina as above described have been found to exist independently of each other. There must therefore be something in the state of the nervous tissues that acts as the predisposing or exciting cause of this aggregate of phenomena. Inflammatory changes and tumours, involving the vagus or the cardiac plexus, have been observed and described. With reference to the state of the heart itself, its cavities have been found dilated and containing blood; or contracted and empty; and theories have been founded thereupon, as to whether death occurred by spasm or by paralysis. It is more than probable that either one or the other of these conditions may occur in angina, and lead to fatal results, according to the particular nerves controlling the functions of the heart which are affected. *See* Pneumogastric Nerve, Disease of.

Clinical Varieties.—All the phenomena of an anginal seizure as above described may be more or less modified. The attack, though generally induced by exertion, may come on when the patient is at rest, and not unfrequently it sets in during sleep. The pain may be comparatively slight, and as such may recur occasionally, it may be, for months or years. On the other hand, it may be so severe as to mark a first, a single, and a fatal attack. In its character the pain may be stabbing or burning; but it is more frequently described as grasping, crushing, or oppressive. It may be limited almost to the region of the heart, or the lower part of the sternum; it may extend all over the chest to both arms, or spread to the side of the head and neck and down one or both legs; and it may in some cases apparently involve the diaphragm. The action of the heart may be slow, weak, and fluttering; or excited and bounding—constituting palpitation; and it may be regular or irregular. The pulse corresponds with the heart's action; in the early stage of a genuine attack it sometimes yields a sphygmographic tracing indicative of extremely high tension. The breathing is sometimes distressing; and although the patient can take a deep breath when asked to do so, he generally avoids this through fear of aggravating the pain. There may be laryngeal spasm. The mental functions are generally undisturbed; yet there is sometimes slight wandering as the attack passes off, and unconsciousness is said to be occasionally observed. The sense of danger of impending death is a characteristic symptom of angina, and one not often absent; whilst a sensation of gasping or choking with difficulty in swallowing is occasionally present. The position of the patient varies; sometimes he sits, sometimes he stands, resting his arms on any convenient object to obtain support; sometimes he sits and stoops, or leans forward. As a rule the attack passes off as abruptly as it commenced, leaving the sufferer free from discomfort; in other cases its disappearance is more slow. The varieties in the symptoms of angina pectoris are thus seen to be remarkably numerous, constituting a form of disease which may be comparatively mild and of long duration, or one of intense suffering, hastening to a fatal termination.[1]

Complications.—Amongst the diseases with which angina pectoris may be said to be associated, rather than complicated, are disorders of the liver and digestive functions, gout, albuminuria, diabetes, and certain diseases of the nervous system. Indeed, so marked is the latter connexion, that Trousseau dwelt on the relation between epilepsy and angina—a relation which seems to depend on the susceptibility to nervous maladies which some individuals present, rather than on any special identity between these two diseases. More than one striking example of the connexion has fallen under the writer's notice; he might mention an instance recently met with in which this susceptibility was such, that an oppressive meal of indigestible food brought on a first and distressing anginal attack, followed by others. In this case brain disease with epilepsy was subsequently developed on the disappearance of the angina.

Progress, Duration, and Terminations.—The progress and duration of this disease will depend wholly upon the nature of its cause. Cases have been recorded in which the first attack proved fatal. The writer has seen several; in three of these cases a *post-mortem* examination revealed the fact that there was slight partial hemorrhage into the walls of the heart, which had been the seat of fatty degeneration, connected with calcification of the coronary arteries. The symptoms in these cases perfectly resembled those of the most severe examples of angina pectoris. It is highly probable, therefore, that

[1] A case has recently come under the writer's notice in which a gentleman accustomed to pass lithic acid, and who for several years has had pains over the right side of the chest as low as the hypochondrium, was seized at night with a severe aggravation of these pains, coldness of the surface, irregular action of the heart, depression, and other symptoms, which, had the attack commenced on the left side of the chest, would have been really called angina pectoris. Similar attacks recurred at intervals for some weeks; they were easily brought on even by walking on a level surface for a few hundred yards. The most careful examination failed to elicit any evidence of organic disease in the organs of circulation or respiration. The patient was recommended to try a course of Homburg waters, and a short residence in Switzerland; from which he returned greatly improved, and almost free from pain. It should be mentioned that an interesting case has recently been recorded by Dr. Morison in which disease of the right side of the heart was accompanied by symptoms of angina affecting the corresponding side of the chest and arm.

some of the cases proving fatal in a first attack of the disease are rather examples of partial rupture of the heart than of what is usually called angina. On the other hand, cases of the disease may continue with interruptions for years; the difference being entirely due to the nature of the cause on which the disease depends. Thus in many instances individuals present all the symptoms of marked angina, accompanied by most of its distressing phenomena, and by the anxieties and fears that they beget; yet these cases, having more a neurotic or gouty origin, yield to treatment, the sufferers being restored to health, and continuing for years to enjoy comparative comfort. On the contrary, in the cases in which angina is connected with organic disease of the heart or of the nerves intimately connected with cardiac action, the symptoms progress in frequency and severity; and the attacks tend, with more or less certainty, to a fatal termination—it may be within a few days or weeks, or it may be, in milder cases, not for years.

Diagnosis.—A typical case of angina pectoris, such as has been described at the commencement of this article, can hardly be mistaken. But when the several symptoms constituting an attack are variously modified, some being lessened in severity and others exaggerated; or when these symptoms depend on, so to speak, remote and removable causes; it is often difficult to say how far the disease is what may be regarded as a passing neuralgia, or an attack of what is commonly recognised as angina pectoris. So also it may be difficult to say, in cases of angina, whether the seizure is dependent on organic lesions which admit of no improvement, or on some condition that is amenable to treatment. It is, therefore, with this, as with most other affections, more difficult to determine the cause on which the symptoms depend, than to recognise the presence of the disease itself. With reference to the diagnosis of the organic diseases of the heart above alluded to, it is unnecessary to repeat here what will be found described under other heads. It remains but to say that in every case the closest scrutiny must be made into the condition of the heart and great blood-vessels, with a view to determine the presence or absence of organic disease. The investigation must further extend to the other viscera, such as the liver, stomach, and the digestive organs generally, as well as to the several other sources from which symptoms of angina may be excited by reflected irritation. Certain symptoms resulting from the presence of other diseases should not be confounded with angina—such, for example, as the pain and dyspnœa caused by pressure of aneurisms or of tumours within the chest; by rheumatic or gouty neuralgia of the chest-walls; by pleurodynia, or acute pleurisy; or by indigestion. Each and all of these conditions must be considered by way of exclusion in determining the nature and origin of the disease.

Prognosis.—In anticipating the future of an attack of angina pectoris, one must be guided chiefly by a knowledge of its cause; in some respects also by its severity; and by the previous history of the case. Thus, if we can ascertain that the attack has been brought on by some clearly established and removable cause, a favourable prognosis may be fairly entertained. On the other hand, if the history of the case tells that there have been several previous attacks, increasing in severity and connected with heart-disease, one can scarcely avoid being led to the conclusion that the disease will tend, with more or less rapidity, to a fatal termination. Between these two classes of cases exist a large majority of the examples of the disease in which the symptoms of angina, of greater or less severity, depend on neurosis, on gouty diathesis, or on other sources of nerve disorder, amenable to treatment; and in which, therefore, a favourable prognosis may to some extent be given. But in all cases great caution should be exercised; for many instances occur in which, from slight and obscure beginnings, severe and even fatal examples of the disease have been developed.

Treatment.—The treatment of angina pectoris must first have reference to relief of the attack itself; and, secondly, during the interval to the removal of the causes on which the attacks may depend.

During the attack, it is necessary first, if possible, to inspire confidence, and remove apprehension. The patient should be allowed to retain the position in which he feels most comfort. Secondly, if the exciting cause is one that can be removed, this should be done; for example, if the stomach be full of undigested food, an emetic of mustard might be given with advantage; or if flatulence be present, peppermint, ether, and other anti-spasmodics will be useful. If cold have produced the seizure, the feet and hands should be immersed in hot water, hot bottles applied to the surface of the body, and poultices of linseed or mustard, or embrocations of chloroform or laudanum, should be placed on the chest. The administration of chloroform internally had better be avoided. The nitrite of amyl, as recommended by Dr. Lauder Brunton, has been found one of the most efficient remedies employed hitherto. Five or six minims of this drug (preserved in a glass capsule) should be inhaled from a handkerchief, and, if necessary, the inhalation may be repeated. Nitro-glycerine is useful ($\frac{1}{100}$ of a minim dose), and hypodermic injection of morphia may be tried with advantage. In cases where debility and exhaustion exist, the ordinary stimulants will be required; and various antispasmodics, such as ether, ammonia, &c., may be given with more or less benefit.

During the intervals.—It is of course desirable to avoid all causes likely to bring on an attack of angina, such as mental excitement, bodily exertion, exposure to cold, and the use of indigestible food or heavy meals. The leading principle in treatment should, however, be to endeavour to determine and to remove, if possible, the cause of the disease. Whether it depend on organic disease of the heart, whether on simple neuralgia, whether on gout or dyspepsia, whether on debility, or on fulness of habit—to each of such conditions must appropriate treatment be directed. A variety of specific remedies have been recommended: such as arsenic, phosphorus, steel, zinc, and the different

anti-spasmodics. Galvanism, in the form of the continuous current from thirty cells, has proved successful in some uncomplicated cases, the positive pole being placed on the sternum, and the negative on the lower cervical vertebræ. Excellent, however, as each of the remedies named may be under special and suitable circumstances, the result of treatment must entirely depend on the cause of the disease, and how far it is within reach of remedy. Some cases of apparently severe angina will be found to yield to treatment; whilst, as might be expected from the nature of the disease, others unhappily proceed to a fatal termination in spite of every effort directed to their relief.

R. Quain, M.D.

ANIDROSIS (ἀ, priv., and ἱδρῶς, sweat). —Absence or want of perspiration. *See* Perspiration, Disorders of.

ANILINE POISON.—The aniline dyes, which are a modern discovery, present the most brilliant hues of yellow, blue, and red; as such they have been used for dyeing stockings, gloves, &c. These articles when worn are apt to produce an intense form of inflammation and vesication of the skin, which is rebellious against treatment, and liable to relapse for many months after the original attack has subsided. *See* Dermatitis.

ANIMAL POISONS. *See* Poisons.

ANODYNES (ἀ, priv., and ὀδύνη, pain). —Definition.—Medicines which relieve pain by lessening the excitability of nerves or of nerve-centres.

Enumeration.—Anodyne medicines include Opium and its alkaloids—Morphia and Codeia; Bromide of Potassium; Cannabis Indica; Belladonna and its alkaloid—Atropia; Hyoscyamus and Hyoscyamin; Stramonium; Aconite and Aconitia; Veratrum and Veratria; Conium and Conia; Lupulus and Lupulin; Gelseminum; Chloroform, Ether, and their allies · Chloral-hydrate; Butyl-chloral-hydrate; and Camphor.

Action.—Pain is due to a violent stimulation of a sensory nerve being conveyed to some of the encephalic nerve-centres (probably the cerebral hemispheres), and perceived there. The impression produced on all sensory nerves, except the cephalic nerves, is conveyed for a part of its course to the head along the spinal cord. The primary impression which is felt as pain, is usually made upon the peripheral ends of the sensory nerves; but it may also be made upon their trunks, upon the spinal cord, or possibly upon the encephalic centres directly, without any affection of the nerves themselves, as, for example, in hysteria. Pain may therefore be relieved, while the source of irritation still remains, by lessening the excitability of the ends of the sensory nerves which receive the painful impression; of their trunks; of the spinal cord along which the impression travels; or of the encephalic centre in which it is perceived. Opium acts by lessening the excitability of the sensory nerves, the spinal cord, and the encephalic ganglia; bromide of potassium is also believed to act on all three, although to a much less degree than opium; belladonna and atropia affect the sensory nerves, as probably does hyoscyamus; stramonium, aconite and aconitia, veratria, chloral and butyl-chloral, lupulus and lupulin, and gelseminum probably act on the encephalic centres.

Uses.—As opium and morphia act upon all the nervous structures concerned in the production of pain, they may be used to relieve pain whatever its cause. Cannabis indica and bromide of potassium may be employed under the same circumstances as opium, but they have very much less power. Chloral seems to relieve pain only by inducing sleep, and does not produce an anæsthetic effect unless it is given in dangerous doses. Butyl-chloral also induces sleep, but seems to have a special sedative action on the fifth nerve; so likewise has gelseminum—and hence both these agents are used in the treatment of facial neuralgia. As the action of belladonna is exerted chiefly on the peripheral ends of the sensory nerves, this remedy is usually applied directly to the painful part in the form of plaster, liniment, or ointment. Aconite, veratria, and opium are also used as local applications in several forms, for the relief of pain. The various anodynes may be administered not only by the mouth, but by other channels, such as by inhalation, by enema or suppository, by hypodermic injection, or by endermic application.

Several therapeutic measures are employed as Anodynes, such as the application of Dry or Moist Heat; Cold; Electricity; various forms of Counter-Irritation; Acupuncture; or the Abstraction of Blood.

T. Lauder Brunton.

ANOREXIA (ἀ, priv., and ὄρεξις, appetite).—Want or deficiency of appetite, not accompanied with disgust for food. *See* Appetite, Morbid conditions of.

ANOSMIA (ἀ, priv., and ὀσμὴ, smell).—Loss of the sense of smell. *See* Smell, Disorders of

ANTACIDS.—Definition.—Medicines used to counteract acidity of the secretions.

Enumeration.—The antacids include Potash, Soda, Lithia, Ammonia, Lime, Magnesia, and their carbonates; as well as the salts which the alkalis form with vegetable acids, such as Acetates, Citrates, and Tartrates.

Action.—Antacids are divided into (1) those which act *directly*, lessening acidity in the stomach; and (2) those which act *remotely*, diminishing acidity of the urine. The alkalis and alkaline earths and their carbonates, with the exception of ammonia, have both a direct and a remote influence; for when swallowed they act on the stomach, and being absorbed from the intestinal canal, they are excreted by the kidneys, thus lessening the acidity of the urine. Ammonia and its carbonate are direct but not remote antacids; for, although they neutralize acidity in the stomach, they are partly excreted in the form of urea, and do not diminish the acidity of the urine. The acetates, citrates, and tartrates of the alkalis and alkaline earths, on the other hand, have no antacid effect in the stomach, but undergo combustion in the blood, being converted into carbonates, in which form they are excreted in the urine, and diminish its acidity.

Uses.—Excessive acidity of the contents of the stomach gives rise to acid eructations and

heartburn. It may sometimes depend on the secretion of a too acid juice by the stomach, but probably is generally caused by the formation of acid from the decomposition of food when the process of digestion is slow and imperfect. Antacids are given after meals to lessen acidity in the stomach, and afford immediate relief to its attendant symptoms. They may prove even more efficacious by preventing acidity when given before meals (*see* ALKALIS). If the action of the bowels be regular, soda is preferable; but lime should be used if they are relaxed, and magnesia if there is a tendency to constipation. Remote antacids are given to lessen the acidity and irritating qualities of the urine in cystitis and gonorrhœa; and to prevent the deposition of uric acid gravel or calculus in gouty persons. For this purpose potash and lithia are preferable, as their urates are more soluble than those of the other bases.

T. LAUDER BRUNTON.

ANTAGONISM.—This term is employed to express the fact that the physiological action of certain substances may be affected, even to the extent of neutralisation, by the presence in the body, at the same time, of other substances having an action of an opposite character. It is important to distinguish between *antidotal action* and *physiological antagonism*. By an *antidote* is meant a substance which so affects the chemical or physical characters of a poison, as to prevent its having any injurious action on living animal tissues. Thus acids and alkalies neutralise each other, so as to form innocuous salts; tannin may render tartar-emetic and many vegetable alkaloids insoluble; and the hydrated sesquioxide of iron may be used to precipitate arsenious acid. In these cases, the action is limited chiefly to the alimentary canal; and the object of administering the antidote is to form insoluble salts, or compounds which will be physiologically inert. But the *physiological antagonism* of certain substances is presumed to take place in the blood or in the tissues. When such a substance as strychnia, for example, is introduced into the alimentary canal, it is quickly absorbed, and carried by the blood throughout the body. It does not, so far as observation has discovered, influence all the tissues; but it so affects the spinal cord, and possibly the brain, as to give rise to severe tetanic convulsions, chiefly of a reflex character. This effect is, no doubt, due either to some interference in the nutritional changes between the blood and the tissues composing the nerve-centres; or to some specific action of the poison on the nerve-centres themselves (*see* AFFINITY). These changes, which are termed physiological, and on which the normal action of the nerve-centres depends, are probably of a molecular or chemical nature; and it is possible to conceive that they may be modified in different ways by different substances. Thus has arisen the idea of physiological antagonism; and experiment has shown that, within certain limits, which will no doubt vary in each case, such an antagonism is possible. Antagonism may be either local, affecting one organ, as is seen in the opposite effects upon the pupil of opium or morphia upon the one hand, and stramonium, hyoscyamus, or belladonna upon the other; or it may extend apparently to more important organs or groups of organs, as in the case of the antagonism between strychnia and the hydrate of chloral. The most important investigations upon the subject of physiological antagonism are the following:—

(1) *Physostigma* and *Atropia*, by Professor Fraser—an inquiry which showed that the fatal effect of three and a half times the minimum fatal dose of physostigma may be prevented by atropia. (2) *Atropia* and *Prussic Acid*, a research by Preyer of Jena—of a more doubtful character as regards the point to be proved, but still sufficient to show that, within certain limits not yet indicated, it is possible to prevent the fatal action of prussic acid by atropia. (3) *Atropia* and *Muscarin* (the active principle of *Agaricus muscarius*):—which were found by Schmiedeberg and Koppe to have entirely antagonistic actions on the ganglia of the heart—muscarin exciting the intra-cardiac inhibitory centres, and stopping the heart in diastole, while atropia has the contrary effect. (4) *Chloral* and *Strychnia*,—an antagonism first pointed out by Oscar Liebreich, who showed that minute doses of strychnia might so rouse an animal from the effects of an overdose of chloral as even to save its life. And (5) *Strychnia* and *Chloral*—with respect to which Hughes Bennett demonstrated the converse of the last-mentioned observation, namely, that in the rabbit a fatal dose of strychnia might be so antagonised by a dose of chloral as to save life.

CONCLUSIONS. — It has unfortunately to be admitted that the practical results of the preceding researches have not been very encouraging. In all of these investigations it was quite apparent that the limits of physiological antagonism were very narrow. Three elements affect the chances of success in the way of saving life:—(1) the age and strength of the animal; (2) the amount of the doses of the two active substances—so that if either the one or the other active substance be given slightly in excess, death will probably take place; and (3) the time between the administration of the two active substances. If the stronger be introduced first, and be allowed to manifest distinctly its physiological action, it is almost impossible to counteract this by that of another substance; but if the two substances be introduced simultaneously, or if the supposed antagonist to the more active substance be introduced first, the chances of success are much greater. It is apparent, therefore, that the facts relating to physiological antagonism at present known in science do not hold out much hope of good results from their application in practice; but still the physiological facts are so definite as to indicate a precise mode of treatment. For example, no one acquainted with the investigations mentioned above would hesitate in attempting to relieve the tetanic spasms of a case of poisoning by strychnia by repeated doses of hydrate of chloral, or by the administration of chloroform. A practical result of such researches is that the principle of physiological antagonism may serve as a guide to the application of re-

medies in disease. Thus excessive secretion, say from mucous membranes or from salivary glands, may be modified or arrested by the use of sulphate of atropia, a striking experimental demonstration of which may be seen in the antagonism between bromal hydrate and sulphate of atropia in the rabbit.

JOHN G. MCKENDRICK.

ANTEFLEXION.—A bending forwards of any organ. The term is specially used in relation to the uterus, when this organ is bent forwards at the line of junction of its body and cervix. *See* WOMB, Diseases of.

ANTEVERSION.—A displacement forwards of any organ. The term is particularly applied to a change of position of the uterus, in which this organ is bodily displaced in the pelvic cavity, so that the fundus is directed against the bladder, and the cervix towards the sacrum. *See* WOMB, Diseases of.

ANTHELMINTICS (ἀντί, against, and ἕλμινς, a worm).—DEFINITION.—Medicines which kill or expel intestinal worms.

ENUMERATION.—The principal anthelmintics are:—Oil of Male Fern; Kamala; Kousso; Oil of Turpentine; Pomegranate Root; Worm-seed and its active principle, Santonin; Areca; Mucuna; Rue; and drastic purgatives. As purgatives only expel the worms, they are termed *Vermifuges*; while the other anthelmintics which kill the worms are called *Vermicides*.

ACTION.—The oil of male fern, kamala, kousso, oil of turpentine, and bark of pomegranate root, act as poisons to tape-worms; worm-seed and santonin kill round-worms, and also thread-worms. Castor oil, jalap, scammony, and other purgatives do not kill the worms, but dislodge and expel them, by the increased peristaltic action which they occasion.

USES.—Drastic purgatives may be used for worms of any sort; areca for both tape- and round-worms; and the other agents for the worms on which they severally act as poisons. Vermicides are generally given after the patient has fasted for several hours, in order that, the intestines being empty, the drugs may act more readily on the worms. A purgative is usually given some hours afterwards, in order to expel the dead worms. As thread-worms chiefly inhabit the rectum, they are most effectually killed by enemata, which may consist of a strong infusion of quassia; salt and water; vinegar and water; solution of sulphate, or of perchloride of iron; oil of turpentine; castor oil; decoction of aloes; or infusion of senna. As abundance of mucus in the intestines forms a convenient nidus for the growth of worms, anything that diminishes this tends to prevent their occurrence; and for this purpose preparations of iron and bitter tonics are useful.

T. LAUDER BRUNTON.

ANTHRAX (ἄνθραξ, a coal).—A synonym for carbuncle, and for malignant pustule. *See* CARBUNCLE; and PUSTULE, MALIGNANT.

ANTIDOTE (ἀντί, against, and δίδωμι, I give.)—DEFINITION.—An antidote is any remedy which, by its physical or its chemical effect upon a poison, or in both ways, is capable of preventing or counteracting the physiological effects of that substance. (*See* ANTAGONISM.) Sometimes, however, the term is used in a more comprehensive sense, so as to include the general treatment of a person affected by a particular poison. Thus, in poisoning by opium, the use of the stomach-pump, enforced exertion, chafing the limbs, and artificial respiration may be included in the general antidotal treatment.

MODES OF ACTION, AND APPLICATION.—Most antidotal substances form with the poison insoluble or innocuous compounds. Without attempting to give a complete list, the following are examples of the more common poisons and their respective antidotes:—(1) *Arsenious acid:* hydrated peroxide of iron, or light magnesia; (2) *hydrocyanic acid:* newly precipitated oxide of iron with an alkaline carbonate; (3) *oxalic acid:* chalk, common whiting, or magnesia suspended in water; (4) *tartar emetic:* tannin, catechu, or other vegetable astringents; (5) *acetate of lead:* sulphate of magnesia, or the phosphates of soda and magnesia; (6) *caustic potash:* dilute acetic acid, fixed oils, lemon juice; (7) *corrosive sublimate:* albumen, white of egg, flour, or milk; (8) *mineral acids:* chalk, common whiting, plaster from the walls or ceiling, or carbonate of magnesia; (9) *chloride of zinc:* albumen, milk, or carbonate of soda.

Vegetable poisons cannot thus be counteracted. If they have been taken in the form of seeds, leaves, or roots, the proper course is to remove them from the stomach or bowels as soon as possible by emetics and purgatives, and at the same time to sustain the flagging strength of the patient by the administration of stimulants. On the other hand, if the alkaloid has been taken, it is so soon absorbed that emetics and purgatives are of little avail, or may even be injurious. In these circumstances we must rely on the administration of the physiological antagonist of the poison (such as chloral hydrate in the case of strychnia-poisoning), and on supporting the strength of the patient. The following are the best antidotes to the vegetable poisons most frequently met with:—(1) *aconite root:* emetic of sulphate of zinc and stimulants; (2) *belladonna leaves* or *root:* emetic of sulphate of zinc, ammonia, stimulants, and after some time an active purgative; (3) *digitalis:* emetics, stimulants, and the maintenance of the recumbent position; (4) *hyoscyamus leaves:* emetics and stimulants; (5) *hydrochlorate* or *meconate of morphia*, or *any of the preparations of opium:* emetic of sulphate of zinc, external stimulation by warmth, turpentine or camphor liniments, enforced exertion, artificial respiration, and small repeated doses of sulphate of atropia; (6) *chloral-hydrate:* the same as for opium; (7) *strychnia* or *nux vomica:* animal charcoal suspended in water, repeated large doses of chloral-hydrate, or chloroform. *See* POISONS.

JOHN G. M'KENDRICK.

ANTIMONY, Poisoning by. *See* TARTAR EMETIC, Poisoning by.

ANTIPERIODICS.—DEFINITION.—Medicines which prevent or relieve the paroxysms of certain diseases which exhibit a periodic character.

Enumeration.—The chief antiperiodics are:—Cinchona-bark and its alkaloids—Quinine, Cinchonine, Quinidine, and Cinchonidine; Bebeera-bark and its active principle, Bebeerin; Salicin, Salicylic Acid and its salts; Eucalyptus globulus; and Arsenic.

Action.—The mode of action of antiperiodics is at present unknown.

Uses.—Cinchona, and still more quinine, is almost a specific in the treatment of intermittent fevers, periodic head-aches, neuralgias, and other affections caused by malaria. Though less certain in its action than in intermittent fevers, quinine is also the best remedy in the remittent fevers of the tropics, in which, however, it must be given in very large doses. The other alkaloids of cinchona have a similar action to that of quinine, but they are not so powerful. Bebeerin is only about one-third as powerful, and is by no means so certain; and the same remark applies to the other remedies enumerated. In some cases of ague and other intermittent affections arsenic proves successful when quinine fails. Emetics and purgatives are useful auxiliaries to quinine in the treatment of ague, and are employed alone for the cure of this disease in some parts of the world where quinine is not available.

T. Lauder Brunton.

ANTIPHLOGISTIC (*ἀντί*, against, and *φλέγω*, I burn).—A term for any method of treatment that is intended to counteract inflammation and its accompanying constitutional disturbance.

ANTIPYRETICS (*ἀντί*, against, and *πυρετός*, a fever). — Definition. — Medicines which reduce the temperature in fever.

Enumeration.—The principal agents used as antipyretics are—Cold Baths, Cold Applications, Ice; Diaphoretics; Alcohol; Chloral; Quinine; Salicylic Acid and its salts; Eucalyptol; Essential Oils; Aconite; Digitalis; Veratria; Purgatives; and Venesection.

Action.—The temperature of the body may be reduced, either by increasing the abstraction of heat, or by lessening its production. The direct application of cold, by means of baths, affusion, or sponging, or by enveloping the body in sheets wrung out of cold water, is the most powerful and rapid means of abstracting heat. But the loss of heat which constantly occurs, even in health, by evaporation of the sweat, and the radiation and conduction of heat from the skin, may be increased by the use of diaphoretics, such as salts of potash, preparations of antimony, or acetate of ammonia; or by such medicines as dilate the cutaneous vessels, so as to allow the heated blood to circulate freely through them, and to become cooled by the external media surrounding the skin. Alcohol, in the form either of wine or spirits, and chloral, have an action of this sort, though alcohol also influences the production of heat. Alcohol, quinine, salicylic acid and its salts, eucalyptol, and essential oils lessen the production of heat within the body, probably by diminishing oxidation of the tissues. (*See* Alcohol.) Aconite, digitalis, and veratria reduce the temperature, but their mode of action is not precisely ascertained.

Uses.—Antipyretics act much more powerfully in reducing the temperature of the body in fever than they do in health. They may be used when the temperature has risen either from exposure to a high external temperature, as in thermal fever; in consequence of inflammation, as in pneumonia, or pericarditis; or in specific fevers, as acute rheumatism, typhus, and scarlatina. The most rapid and powerful antipyretic remedies are cold baths; next probably come large doses of salicylic acid and quinine. The latter seems to act very efficiently in thermic fever when injected subcutaneously.

T. Lauder Brunton.

ANTISEPTICS.—Antiputrescents (*ἀντί*, against, and *σηπτικός*, putrefying).

Definition. —An antiseptic is a substance which prevents or retards putrefaction, that is, the decomposition of animal or vegetable bodies accompanied by the evolution of offensive gases. The putrefactive change occurs only in dead matter, and requires the presence of water, heat, and a ferment. That there is no putrefaction in the absence of water is obvious, for bodies, such as albumin and blood, which in the moist state are highly susceptible of putrefaction, may be kept for an indefinite time without change if they be perfectly dry. Heat also has an important influence on putrefaction. At very low temperatures the putrefactive change ceases, while elevated temperatures, such as prevail in tropical climates, are favourable to it. An additional element besides heat and moisture is, however, required, and the opinion generally accepted at present is, that this consists of minute vital organisms, which in some way excite putrefactive decomposition.

Mode of Action.—The substances used as antiseptics act either directly on the bodies in which putrefaction is occurring or might occur, forming with them combinations that are not susceptible of the decomposing action of a ferment; or they act indirectly, by destroying the vitality or otherwise preventing the development and propagation of the organisms of which the ferment is composed. In this respect *antiseptics* are distinguished from *disinfectants*, the action of the latter being directed only towards the exciting causes and offensive or deleterious products of a class of changes which are themselves more comprehensive than those implied by the term putrefaction.

Enumeration.—There are numerous chemical agents possessing antiseptic properties, the chief of these including Chlorine, Sulphurous Acid, Nitric Oxide, and Peroxide of Nitrogen, as gases; Carbolic Acid, Creasote, Benzol, Sulphites and Hyposulphites, and the Hypochlorites, which emit vapours at common temperatures; Chromic, Boric, Tannic, and Salicylic acids, Permanganate of Potash, Sulphocarbolates, Chlorate of Potash, Chloride of Zinc, and Charcoal, from which no vapour is emitted.

Uses.—1. In therapeutic practice antiseptics are chiefly employed in the treatment of surgical operations and open wounds, to prevent the occurrence of putrefactive decomposition. Those antisep-

tics are best suited for this purpose which, acting efficiently on the ferment, have little action, and no injurious effect, on the parts in which the healing process is going on. Gases, except in solution, cannot be readily used, as it would be necessary to enclose the substance to be preserved in an air-tight vessel containing the gas. The volatile antiseptics which slowly emit a vapour have been preferred to those which emit no vapour, although among the latter salicylic and boric acids, being devoid of any irritating properties when applied to inflamed surfaces, would on this account present a marked advantage.

Carbolic acid has been used with success, a solution in water containing one part of the crystallised acid in from forty to one hundred parts of water being applied as a lotion, and also in the form of spray, diffused through the atmosphere during a surgical operation or the dressing of a wound. The carbolic acid solution may also be used on lint or cotton-wool for covering the affected part. Antiseptic gauze for a similar purpose may be made by adding one part of crystallised carbolic acid to five parts of common resin and seven parts of paraffin melted together, and applying the compound to coarse muslin, so as to form a thin coating of the plaster over the gauze, which, when it has hardened, is used for covering the parts to be protected. Professor Lister has also recommended a boric acid dressing for rodent ulcers, which is composed of boric acid and white wax, each one part, paraffin and almond oil each two parts. The boric acid and oil are added to the melted wax and paraffin, and the whole stirred in a mortar until it thickens, then set aside to cool and harden, after which it is to be rubbed in the mortar until it acquires the consistence of an ointment. This is thinly spread on fine rag and applied to the wound. The oil separates, and is absorbed by lint or rag placed over the dressing, while a firm plaster remains attached to the skin, which is easily removed when necessary. Salicylic acid may be substituted in this dressing for the boric acid. In some cases salicylic acid is applied alone, by merely sprinkling it in fine powder over the part affected. Its very slight solubility in water presents an obstacle to its use in solution, unless something be added to render it more soluble; and borax, which is itself a good antiseptic, may be used for that purpose. One drachm of salicylic acid, two drachms of borax, and half an ounce of glycerine, with three ounces of water, form, if aided with a little heat, a clear solution which may be used as an antiseptic lotion.

2. In medical practice antiseptics are also employed, either as local applications or as internal remedies. Those which are chiefly available include creasote, carbolic acid, the sulphocarbolates, sulphurous acid, the sulphites or hyposulphites, chlorine water, permanganate of potash, borax or boric acid, chlorate of potash, charcoal, salicylic acid, and thymol. They are principally used for the prevention and treatment of infectious fevers; and in low forms of ulceration of the throat.

3. In using antiseptics for the preservation of anatomical specimens, a wider range of chemical agents may be taken, and a selection made of substances that would be inapplicable in the treatment of the living subject. Arsenious acid, corrosive sublimate, or chloride of zinc in solution are of service for this purpose, and chromic acid, even when diluted with from five hundred to one thousand parts of water, possesses the property of preserving animal matter from decomposition, as also does a solution of one part of borax in forty parts of water.

Besides the more powerful antiseptics noticed, others of a milder nature, such as common salt, nitre, and sugar, are used for preserving articles of food; while alcohol and glycerine are employed for the preservation of animal and vegetable substances as specimens. T. Redwood.

ANTISEPTIC TREATMENT is treatment directed against putrefaction, or rather, as now generally understood, against the development of fermentative organisms.

1. In Surgery, the employment of the antiseptic method is based upon the theory which attributes putrefaction and its consequences to minute organisms (bacteria, &c.) derived from without.

The treatment yields the most satisfactory results when it is so employed as to prevent, rather than to attempt to correct putrefaction. To obtain these results the surgeon must have unbroken skin to operate upon, or the wound must have been so recently inflicted that there has not been time or opportunity for the septic organisms to get beyond the reach of the antiseptic which he employs. Hence there must always be a percentage of failures in the treatment of compound fractures and large lacerated and contused wounds, owing to the amount of septic air and dirt carried into the recesses of the wounds between the time of the injury and the commencement of the treatment. In the event of putrefaction occurring in such a case, antiseptic dressings should be continued, but the question of operative interference must be determined according to the ordinary principles of surgery. Putrid ulcers and superficial wounds may certainly be rendered aseptic by suitable means, and so probably may cavities laid open during excision or amputation; but the attempt to correct putrefaction in deep sinuses, such as those connected with caries of vertebræ, is hopeless, though by appropriate dressings the putrid emanations may be rendered less noxious to the patient and those about him.

The antiseptics which have been found most suitable are carbolic acid, boric acid, chloride of zinc, and salicylic acid.

Carbolic acid is the antiseptic most generally useful. A solution of one part to twenty of water is employed to purify the skin of the part to be operated upon, the sponges, instruments, &c. A solution of one part to forty is used for washing sponges during an operation, for the hands of the surgeon and assistants, and for the changing of dressings. The volatility of carbolic acid renders it invaluable for dressing hollow wounds and abscesses. It is the active constituent of the ordinary dressing—antiseptic gauze, which is applied in eight layers, of size proportioned to the expected quantity of discharge, a piece of reliable thin mackintosh cloth (hat lining) being interposed beneath the outer layer of gauze; this serves to prevent the dis-

charge from soaking directly through the central part of the dressing, thereby washing out the stored up acid, and allowing the direct access of putrefactive organisms to the cavity. Disastrous consequences have followed from a defect in the mackintosh. A small portion of gauze wrung out of the one-to-forty carbolic acid solution is applied over the wound before the ordinary eight-fold dressing, so as to prevent possible mischief from putrefactive organisms accidentally adherent to the inner layer of the gauze, which might not otherwise be destroyed, owing to the slight volatility, at the ordinary temperature of the atmosphere, of the acid stored in the gauze. The gauze is also useful, on account of its antiseptic properties, as a bandage in retraction of the soft parts in stumps, and in any case in which free discharge is expected.

In addition to other measures, there must be an antiseptic atmosphere provided, so that the air which gains access to the wound or abscess may be innocuous. This is secured by means of a spray of one-to-forty carbolic acid solution, for the production of which Lister's portable steam apparatus may be used. When the spray is suspended during an operation or the changing of a dressing, the wound is covered with a piece of sound calico moistened with the same solution. Of course superficial sores and wounds require neither spray nor guard.

Cicatrisation is promoted by interposing between the healing parts and the antiseptic agent an impervious, unirritating protective layer, composed of thin oil-silk varnished with copal and then coated with a layer of dextrine, which allows the oil-silk to be uniformly wetted by the antiseptic solution into which it is dipped at the moment of application. The antiseptic dressing proper must extend a considerable distance beyond the protective layer, so as to prevent the access of putrefactive organisms beneath it.

Lint soaked in a one-to-ten solution of carbolic acid in olive oil is used as a dressing for abscesses near the anus, and occasionally as a stuffing for cavities. A one-to-twenty oily solution is smeared upon urethral instruments to prevent putridity of urine and its consequent evils.[1]

Boric acid is a powerful antiseptic, but its non-volatility prevents its being used for the dressing of hollow wounds and in the form of spray. It is bland and unirritating as compared with carbolic acid, and is therefore particularly serviceable as a dressing for superficial wounds and sores. It is employed in the form of a saturated watery solution; as an ointment, in the proportion of one to six; and as boric lint, which contains about half its weight of the acid.

Chloride of zinc has the remarkable property of producing such an effect upon the tissues of a recent wound, that when applied once as a watery solution of about forty grains to the ounce, the cut surface, though not presenting any visible slough, is rendered incapable of putrefaction for two or three days, even when exposed to the influence of septic material. The patient is thus tided over the dangerous period preceding suppuration, during which the divided tissues are most prone to inflammation and the absorption of septic products. Hence this agent, though not adapted for general use, is of the highest value when it is impossible to exclude septic organisms in the after-treatment, as, for example, after the removal of tumours of the jaws, in operations about the anus, and in amputations or excisions in parts affected with putrid sinuses, which should first be scraped out with the sharp spoon.

Sometimes a peculiar, disagreeable odour is observed on removing an antiseptic gauze dressing which has been applied for several days, especially to regions which have naturally a powerful odour, as the axilla or groin; and occasionally the odorous material is so irritating as to produce actual eczema around the wound. This seems to depend upon a reaction between the discharge or excretion and some ingredient of the gauze. *Salicylic acid* has the power of preventing this reaction, or, at any rate, of obviating or remedying its bad effects, if a little of the acid is smeared upon the protective or upon the inner layer of gauze. Salicylic acid has been introduced as an independent dressing by Prof. Thiersch, but has been found by Prof. Lister to be inferior to carbolic acid for the destruction of bacteria, though very efficient in preventing fermentations. *Chloral*, *thymol*, and *Eucalyptol* are used as antiseptics. Mr. Lister recommends gauze containing oil of Eucalyptus when symptoms of poisoning follow the use of the ordinary gauze dressing.

Prepared antiseptic catgut is employed for arresting arterial hæmorrhage.

Chassaignac's drainage-tubing is introduced to prevent tension after the opening of an abscess, or after the application of antiseptics to the raw surface of a hollow wound.

Carbolised silk sutures are used, as they are not liable to catch in the dressings.

2. In Medicine, antiseptic treatment is based on the hypothesis that infectious and contagious diseases are caused by the presence and multiplication in the human organism of minute parasites, termed microzymes, microphytes, micrococci, &c. On this assumption, special remedies are administered for the purpose of destroying these minute organisms, or of rendering the blood and other tissues incapable of sustaining them. The treatment further aims at preventing the spread of these diseases by the prophylactic administration of antiseptic remedies to persons who are compelled to remain in infected places.

At present a definite relation would seem to have been made out between specific microphytes and cow-pox, sheep-pox, splenic fever, and relapsing fever respectively; whilst a similar connection has been so far supported by observations in the case of measles, scarlatina, diphtheria, enteric fever, and erysipelas; but much remains to be done before the true relation between microphytes and infectious diseases can be established. Seeing that antiseptic therapeutics depends on an unestablished ætiology, it cannot be expected to be in a very advanced condition; accordingly there is at present but little that is settled or satisfactory to be said. The *sulphites*

[1] Cystitis, thus complicated with putridity of the urine, due to infection by catheters, may often be benefited by washing out the bladder with solution of boric acid. This complication of course never arises when the instruments have been carbolised from the commencement of the treatment.

and *hyposulphites*, introduced by Professor Polli in 1857, have been freely given in zymotic diseases in twenty-grain doses every three or four hours, and with apparently good effect.

Carbolic acid is also said to have been successfully used in diphtheria and in intermittent and eruptive fevers, in doses of from one to five minims or more.

The *sulphocarbolates*, introduced by Dr. Sansom in 1867, have been used with success in many diseases. They produce very little physiological effect, and seem to deserve increased attention. Dr. Brakenridge believed that he found sulphocarbolate of soda remarkably beneficial in an epidemic of scarlatina in 1875. Patients under ten years were given five grains, and those above that age twenty grains, every two hours. Also, according to this authority, the prophylactic effect of ten-grain doses three times a day was very striking.

Thymol and *salicylic acid* have also risen into favour, owing to their powerful antiseptic effects being associated with comparative physiological inertness.

Sarcinous dyspepsia is greatly relieved and sometimes cured by Kussmaul's method of washing out the stomach with solution of permanganate of potash, or some other antiseptic.

Reference must be made to solution of permanganate of potash, solution of carbolic acid, glycerine of borax or a preparation of boric acid of the same strength, sulphurous acid, and chlorate of potash, as applications to the throat in such diseases as diphtheria and scarlatinal tonsillitis, or in any form of sloughy ulceration of this part. To these may be added a five-grain solution of sulphate of quinine.

JOHN BISHOP.

ANTISPASMODICS (*ἀντί*, against, and *σπάσμα*, a spasm).—DEFINITION. — Medicines which prevent or allay spasm.

ENUMERATION.—Antispasmodics may be arranged in groups as follows:—Valerian, Valerianic Acid and its salts; Musk, Castor, Assafœtida, Sumbul and Galbanum, Camphor, Brominated Camphor, Oil of Amber; Ammonia and its Carbonate; Alcohol, Ether, Acetic Ether, Chloroform, Nitrite of Amyl; Bromide of Potassium, Bromide of Ammonium; Conium, Lobelia, Opium, Gelseminum, Indian Hemp, Belladonna, Stramonium; and the Essential Oils. As adjuvants may be mentioned—Cold Baths, moderate Exercise, Friction, Heat, and Moisture; and also Quinine, Arsenic, Zinc, and Silver.

ACTION.—Certain nerves and nerve-centres, when excited, produce contraction of voluntary or involuntary muscular fibres; other nerves and centres arrest movements; and by the combined action of these two systems the motions of the various contractile structures in the body are regulated, and subordinated to the requirements of the organism as a whole. Excessive contraction or spasm of one part of the body may therefore arise either from excessive action of the motor, or deficient action of the inhibitory centres. Spasm may affect the involuntary muscular fibres of the intestines—as in colic; of the vessels—as in some forms of headache, and in vaso-motor neuroses of the uterus and bladder: single voluntary muscles, or groups of muscles—as in various forms of cramp: or the muscular system generally—as in tetanus, epilepsy, and hysteria. Antispasmodics may act by lessening the irritability of motor centres, as, for example, bromide of potassium and conium; or by stimulating those portions of the nervous system which restrain and co-ordinate movements, as alcohol probably does. There are no direct experiments to show the action of antispasmodics on the inhibitory centres; but it seems probable that they have such an action, although it may not be confined to these parts alone. Thus small doses of alcohol and ether, which stimulate the nervous system generally, and usually increase motor activity, will restrain and co-ordinate excessive muscular action, as in colic, nervous agitation, trembling, and hysteria. It is at present impossible to localize the part of the nervous system affected by valerian, assafœtida, and other drugs of this class. As spasms occur when the nervous system is deficient in power, nervine and general tonics, such as quinine, zinc, and iron, are often found to be useful adjuvants.

USES.—In such convulsive diseases as epilepsy, laryngismus stridulus, and infantile convulsions, bromide of potassium is the most powerful antispasmodic; in hysteria—valerian, assafœtida, and the bromides; in chorea—arsenic, conium, copper, and zinc; in spasmodic asthma—lobelia and stramonium; in spasm of the blood-vessels—nitrite of amyl. In all spasmodic affections, cold baths or sponging, exposure to sunlight, moderate exercise, and a plain but nutritious diet should be employed; and late hours, a close atmosphere, exhausting emotions, or excessive bodily or mental work should be avoided. T. LAUDER BRUNTON.

ANURIA.—Absence of urination, whether from suppression or retention of urine. *See* MICTURITION, Disorders of.

ANUS, Diseases of.—The principal affections of this part are Congenital Abnormalities; Epithelioma; Irritable Sphincter Ani; Irritable Ulcer; Prolapsus; Prurigo; Tumours and Excrescences.

1. **Congenital Abnormalities** (*Atresia*) may be classed as follows:—1. Imperforate anus without deficiency of the rectum. 2. Imperforate anus, the rectum being partially or wholly deficient. 3. Anus opening into a *cul-de-sac*, the rectum being partially deficient. 4. Imperforate anus in the male, the rectum being partially deficient, and communicating with the urethra or neck of the bladder. 5. Imperforate anus in the female, the rectum being partially deficient, and communicating with the vagina or uterus. 6. Imperforate anus, the rectum being partially deficient and opening externally in an abnormal situation by a narrow outlet. 7. Narrowness of the anus. These imperfections can be remedied, if at all, only by operation.

2. **Epithelioma.**—The anus, like other parts, where a junction takes place between the skin and mucous membrane, is liable to epithelioma. It is easily recognised by the ordinary characters of the sore. Warty growths and flaps of skin at this part are subject to this form of degeneration. The treatment applicable to this disease

is to destroy or remove the growth by caustics or excision.

3. **Irritable Sphincter Ani.**—In this complaint the anus is strongly contracted and drawn in by the action of the sphincter. Any attempt to examine the part produces spasm, and the finger passed through it is tightly grasped as if girt by a cord. In cases of old standing the muscle becomes hypertrophied, and forms a mass encircling the finger like a thick unyielding ring. This state is the source of serious trouble in defecation, owing to the expulsive power of the bowel being insufficient to overcome the impediment caused by the muscle to the passage of the fæces. Irritability of the sphincter occurs generally in hysterical females, and is relieved by mild laxatives, the local application of an opiate or belladonna ointment, and the occasional passage of a bougie coated with a sedative ointment.

4. **Irritable Ulcer.**—This is a small superficial sore, situated just within the circle of the sphincter, usually at the back part, commonly known as *fissure*, from its appearance in the contracted state of the part. The fæces passing over the sore excite spasm of the muscle, and cause a sharp burning pain which lasts for two or three hours. The distress often does not come on till an interval of ten minutes or more has elapsed after defecation. The pain is sometimes so acute that patients resist an action of the bowels, and allow them to become costive. The irritable ulcer occurs usually in middle life, and is more frequent in women than in men. It seldom gets well under the influence of local applications, but an incision through the centre of the sore sets the muscle at rest, and allows the part to heal. The French surgeons use forcible dilatation, so as to rupture the sphincter—a rough mode of treatment not to be commended. When the suffering is moderate, a cure may be attempted by giving a laxative to ensure soft evacuations; by enjoining rest in the recumbent position; and by the application of mercurial ointment with morphia, belladonna, or chloroform.

5. **Prolapsus.** *See* RECTUM, Diseases of.

6. **Prurigo.**—Itching, though a common symptom in disorders of the lower bowel, may occur as a distinct affection, a neurosis liable to paroxysms. It is caused by worms in the rectum, and by congestion of the hæmorrhoidal veins. Patients suffer more after taking stimulating drinks and when heated in bed. The itching is extremely teasing and annoying, especially at night, keeping the sufferer awake for hours. Friction aggravates the mischief, excoriates the skin at the margin of the anus, and causes it to become dry, harsh, and leathery. As regards treatment, stimulants and condiments are to be avoided. The bowels should be regulated, and the part should be washed with soap and water after each evacuation. Every effort should be made to avoid friction. A piece of cotton wool soaked in oxide of zinc lotion should be kept applied to the anus, or the part may be smeared with some mercurial ointment, such as the dilute citrine, or one containing the grey oxide of mercury. Lotions of carbonate of bismuth and glycerine, of borax and morphia, or of carbolic acid, are often efficacious. In weak persons quinine and arsenic help the cure.

7. **Tumours and Excrescences.**—Besides the flaps and folds of integument consequent on external piles, tumours of a *fibrous* texture sometimes form in the sub-cutaneous areolar tissue, which as they increase become pedunculated. They are usually small in size, lobulated, and have a firm feel. These growths may be easily and safely removed by excision. *Warts* are liable to be developed around the anus, and sometimes grow so abundantly as to constitute a large cauliflower-looking excrescence. They then form projecting processes of various sizes, densely grouped together, with their summits isolated, expanded, and elevated on narrow peduncles. They give rise to a thin offensive discharge. They originate in want of cleanliness. In some persons there is so strong a disposition to the formation of warts that it is difficult to prevent their growth. If few in number and small in size, they may be destroyed with strong escharotics. They usually require, however, to be removed by excision, the quickest and most effectual mode of treatment. Astringent lotions must afterwards be used to prevent the reproduction of the warts. Flattened growths from the skin, commonly called *mucous tubercles*, a secondary result of syphilis, are liable to occur around the anus. They yield readily to the local application of mercury and specific general treatment.

T. B. CURLING.

ANXIETAS.—Anxiety or distress, whether subjectively felt, or expressed in the features, attitude, or general behaviour. The term is also specially associated with a peculiar sensation experienced in the region of the heart. *See* PRÆCORDIAL ANXIETY.

AORTA, Diseases of.—The diseases to which the aorta is liable may be thus considered:—1. Aortitis, Acute and Chronic; 2. Atheroma; 3. Primary Fatty Degeneration; 4. Primary Calcification; 5. Coarctation; 6. Simple Dilatation; and 7. Aneurism.

1. **Aortitis.**—*Acute aortitis* is exceedingly rare. It may result from the direct irritation of an atheromatous aorta by a thrombus or an embolus, in persons of gouty diathesis; but has never been observed as an extension of acute endocarditis. The *morbid changes* consist in hyperæmia, with thickening and softening of the coats of the vessel, and deposit of fibrin upon its internal surface. The ascending portion of the arch is the part most frequently affected. The *symptoms* are acute substernal pain with oppression, palpitation, quick and feeble pulse, and elevated temperature. With these symptoms may be associated a harsh systolic murmur, originating at the seat of inflammation, and transmitted to a distant point of the aorta.

Sub-acute and *Chronic Aortitis.*—These are the usual forms of inflammation of the aorta. The disease may be general, arising from a blood-dyscrasia such as gout, from pyæmia, or from the various septic agents; but it is usually limited to a definite portion of the vascular surface, being the result of local irritation.

ÆTIOLOGY.—Excessive and continued strain of the vascular walls is, according to its degree, the most frequent cause of sub-acute and chronic aortitis. Hence, the portion of the arterial system

most directly affected by the impulse of the left ventricle, namely, the arch of the aorta, is that in which inflammatory irritation is first, and often exclusively, exhibited. Labour of any kind requiring great and repeated muscular effort whilst the breath is held, must necessarily subject the aorta to extreme tension, partly through the obstruction arising from the pressure of the contracted muscles upon the subjacent arteries, and partly from the back-pressure of the distended veins. Hence, sledgers, rammers, ship-porters, &c., are those who most frequently suffer from the effects of aortitis. As a necessary result of such efforts the left ventricle soon becomes hypertrophied, and the evils arising from vascular tension are thereby proportionately increased. Furthermore, the free use of alcoholic stimulants, in which such labourers habitually indulge, contributes to the same result by imparting irritant properties to the blood. The British soldier has been especially liable to the evils above sketched, owing to a vicious system of forced drill with a breathing-capacity diminished by faulty construction of his dress and accoutrements.[1]

Anatomical Characters.—Sub-acute aortitis occurs in disseminated patches, and involves all the coats of the vessel. These are infiltrated with exudation-cells at an early period; become soft and tumid, assuming a bluish-white tint; and, owing to loss of normal elasticity, project outwards, thus causing unevenness or pitting of the internal surface. In the aorta the inflammation is usually primary; but exceptionally it may be produced by the mechanical irritation of an embolus derived from an inflamed focus. Inflammatory softening is a frequent cause of aneurism at all periods of life; and in the young it is the ordinary precursor of that disease.

In chronic aortitis, which is the most common form of the disease, the internal coat is alone involved. The outer portion of the intima exhibits the result of irritation in the abundant production of new cells. These cells occupy the fusiform spaces between its lamellæ, and, gradually distending them, ultimately project the internal and unaffected portion of the tunic into the lumen of the vessel. The prominence so caused is comparatively solid, presents a faint bluish tint, and constitutes the condition described as 'fibroid or semi-cartilaginous thickening.' The inflammatory product is prone to undergo fatty degeneration, and the consecutive change called atheroma.

2. **Atheroma.**—This morbid condition is most common in the first portion of the aorta.

Anatomical Characters.—Atheroma commences with inflammatory overgrowth by multiplication of the cells of the outer portion of the intima, as described in a preceding paragraph. The neoplasts, from their situation, readily undergo fatty change and caseation; the septa of unaltered tissue intervening between them soon lose their vitality and are absorbed; and the disease thus spreads, whilst it advances through the same agency towards the internal surface of the vessel. Examined microscopically, atheromatous matter is found to consist of fat granules, crystals of cholesterine, and tissue-débris. At an early stage collections of this matter may undergo liquefaction, and, projecting into the vessel, covered only by a thin layer of the unaltered intima, constitute a so-called *atheromatous abscess*. Should this establish a communication with the artery, an *atheromatous ulcer* will be the result, and, consecutively, a false aneurism.

In the most advanced stage of atheromatous change many patches undergo calcification by deposit of lime-salts in the altered cells. The calcareous lamellæ so formed, being concentric with the vessel, and contracting by loss of their liquid constituents, may erode the intima by their sharp edges. From the injury thus inflicted aneurism may arise, or interstitial thrombosis, by which the vessel may be entirely blocked and gangrene of the extremities produced. In consequence of the foregoing changes the vessel loses its elasticity and becomes dilated; its internal surface is mottled with yellow or fawn-coloured patches of various sizes, being also rough, spiculated, and fissured; and thus the condition described by Virchow under the name of *Endarteritis Chronica Deformans* is established.

The uric-acid and oxalic-acid diatheses favour these changes, not only by stimulating the minute arteries to contract, and so raising the blood-pressure in the larger vessels, but likewise by furnishing material for cretification. The subjects of constitutional syphilis are liable to 'ulcerated steatomatous' (atheromatous) changes of the intima.

3. **Primary Fatty Degeneration.**—Virchow has described, under the name of *fatty erosion*, a form of fatty degeneration of the cells of the internal coat, unpreceded by inflammation, commencing on the free surface, and gradually extending outwards. The internal surface of the vessel is marbled with minute yellow dots, which are groups of fatty cells; these undergo liquefaction; and disintegration of the internal coat, followed by aneurism, is the usual result.

4. **Primary Calcification.**—Exceptionally, in the distant portions of the aorta the muscular fibre-cells of the middle coat are liable to calcification, as a remote result of endarteritis. Owing to the transverse arrangement of the calcified cells, fissuring of the middle coat under the pressure of the blood-current, and dissecting aneurism, are ordinary results of this change. Finally, the entire middle coat, and even all three coats of the artery, may be infiltrated with lime-salts as a primary change. This is most probably due to precipitation of these salts from the congested *vasa vasorum*, in consequence of the escape of their ordinary solvent, carbonic acid.

5. **Coarctation or Stenosis.**—This condition may be either *congenital* or *acquired*.

Congenital stenosis of the aorta is most frequently located at the point of junction of the *ductus arteriosus*, and is of very limited extent; in many cases presenting the appearance of a linear constriction, or of a perforated diaphragm. In a few examples, the vessel, at the seat of contraction, has been entirely closed and converted into a ligamentous cord. On the cardiac side of the constriction the aorta is dilated, and

[1] Also by the constrained and fixed position in which the walls of the chest are placed when the shoulders are forced backwards, with the view of producing the appearance of an expanded chest.—Ed.

often thickened and atheromatous, whilst on the distal side it is reduced in calibre as far as the junction of the collateral vessels. Congenital stenosis of the aorta is compatible with life of moderate duration. In twenty-four out of thirty-eight cases analysed by Dr. Peacock the age attained varied from twenty-one to fifty years. The diagnosis of the condition rests mainly on disproportionate pulsation of the arteries arising from the aorta on the cardiac, as contrasted with those on the peripheral side of the obstruction; and on the enlargement of the collateral vessels, namely, the transverse cervical, internal mammary, and intercostals. The ordinary consequences are exhibited in dilated hypertrophy of the left ventricle, and inadequacy of the aortic valves. Death usually occurs from progressive debility and failure of the left ventricle; from pulmonary congestion; or from dissecting aneurism of the ascending portion of the arch. Congenital stenosis of the entire arch may result from imperfection of the inter-ventricular septum or patency of the foramen ovale allowing the blood to take an exceptional course.

In the *acquired* form, stenosis of the aorta at any portion of its course may result from inflammatory thickening or calcareous change of the coats of the vessel, followed by thrombosis; or it may follow the natural cure of an aneurism. The aorta may be much reduced in calibre without being disproportionately narrowed. Such will be its condition in connection with mitral inadequacy in early childhood, should the patient survive a few years. In such cases the left ventricle will have become dilated and hypertrophied, and a marked disproportion will be observed between the force of cardiac and that of radial pulsation. This circumstance, taken in conjunction with the age of the patient, the existence of disease at the mitral orifice, and hypertrophy of the left ventricle, would warrant the positive diagnosis of narrowing of the aorta.

6. **Simple Dilatation** of the aorta consists in a uniform enlargement of the vessel or of a portion of it, from impairment or loss of its normal elasticity; and depends primarily upon arterial obstruction or resistance beyond its seat, and directly upon consecutive hypertrophy of the left ventricle. The continued tension, to which the walls of the aorta are subjected between these two opposing forces, necessarily leads to progressive impairment of nutrition and loss of elasticity in its middle coat. The immediate consequence of this change is exhibited in further hypertrophy of the left ventricle; and its remote effects in still further impairment of nutrition and deterioration of tissue in the vascular tunics, through the increased tension to which they are now exposed. No elementary change of structure is, however, discoverable. Simple dilatation of the aorta commences in the ascending portion of the arch, and to this it is usually limited; but it occasionally extends into the transverse portion. The other portions of the vessel are never dilated, except in association with atheromatous change. The condition under notice is manifestly in close relationship with inflammatory irritation of the vessel. It has, however, a distinct pathological existence, analogous to that of the early stage of vesicular emphysema of the lung.

No morbid results, with a single exception, are directly traceable to simple dilatation of the aorta. But, should the dilatation extend into the transverse portion of the arch, and engage especially its superior wall, the primary branches may become tortuous, and exhibit abnormal pulsation in the neck, simulating aneurism. In a noteworthy example observed by the writer the existence of this pulsation on *both* sides of the neck, and the facility with which it was arrested by forcibly extending the neck and shoulders, and so unbending the vessels, sufficed to establish the diagnosis. Tortuosity of the cervical arteries, dependent upon a local dilatation of the aorta, may be confined to one side of the neck.

Simple dilatation of the aorta most frequently occurs in connection with the contracted or granular form of chronic renal disease. It may, however, likewise arise from simple functional hypertrophy of the left ventricle dependent upon habitual vascular excitement; or from dilated hypertrophy consecutive to inadequacy of the aortic valves.

7. **Aneurism.**—ÆTIOLOGY AND PATHOLOGY.—Aneurism of the aorta is essentially a disease of the middle period of life. Of ninety-two cases observed or analysed by the writer, sixty occurred between the ages of thirty and fifty years; twelve over fifty; and five under thirty years. Thus, whilst deterioration of the arterial coats as typified in atheroma is most common after the age of sixty, one of its ordinary consequences, aneurism, belongs to an earlier period of life. The apparent discrepancy may be explained by the more frequent employment of men under fifty in severe labour, and their greater capacity for extreme muscular effort then than later in life, the condition of the arterial wall which favours aneurism having been already established. Aortic aneurism is more common amongst males than females in the proportion of about 8 : 1—a difference no doubt due to the more active and laborious habits of the male sex. Soldiers, mechanics, and porters suffer from it in larger proportion than those of other callings; and in most instances the first symptoms of aneurism of the aorta may be traced to a great muscular effort involving vascular strain, or to a severe shock or blow, causing a direct contusion.

Aneurism of the aorta is always consecutive to disease of its coats. Inflammatory softening, atheroma, and calcification are the usual antecedent conditions, and in exceptional instances primary fatty or calcific transformation of the internal and middle coats; whilst a definite overstrain or a direct contusion of the vessel is frequently the immediate cause of the disease.

ANATOMICAL CHARACTERS.—Aortic aneurism may be presented under the following forms, viz., (*a*) *true;* (*b*) *false* (*circumscribed*, and *diffused* or *consecutive*); (*c*) *dissecting;* and (*d*) *varicose.*

a. True aneurism of the aorta is rare; it may be either fusiform or saccular. It is essentially transitional, leading to the false variety of the disease; and differs from simple dilatation of the aorta only by its sharp limitation, and by

the existence of inflammatory products in its walls. True aneurism never contains clots, save by incidental thrombosis; and rarely, as such, attains dimensions capable of producing extrinsic symptoms or signs. It may, however, unlike simple dilatation, be the cause of valvular inadequacy, and so give rise to a murmur of reflux at the orifice of the aorta.

b. False aneurism is either *circumscribed* or *diffused. Circumscribed false aneurism* (or, as it is also termed, *false aneurism*) is the most common form of the disease in connection with the aorta. It is necessarily confined to a portion of the circumference of the vessel, the yielding of which relieves the remainder from extra tension. Hence, it is usually saccular in general outline; but, owing to unequal resistance at different points of its surface, it may, and commonly does, present one or more secondary prominences. The internal and middle coats are usually broken;—the adventitia supplemented by the surrounding structures more or less condensed, forming the sac.

Disintegration of the inner coat, already in a state of atheromatous change by mechanical strain or vascular tension, is ordinarily the immediate cause of false aneurism. The irruption of an 'atheromatous abscess' may also give rise to it; so likewise may ulceration of the intima from fatty erosion. Rupture of the coats of the vessel by mechanical strain is usually announced by definite symptoms of the utmost significance, namely, a feeling of something having given way within the chest or abdomen; followed by faintness often amounting to syncope, dyspnœa, palpitation, and occasionally hæmoptysis. These symptoms of shock usually subside within a period of one to two hours, but the patient is thenceforward incapable of his accustomed exertion, being easily put out of breath, and distressed by excitement or rapid movement, especially that of ascent; there is likewise a fixed pain at some point of the chest, back, or abdomen. A fusiform false aneurism may become 'invaginating' by abruptly expanding and ensheathing the artery at its proximal or distal side, or in both these situations.

Diffused false aneurism (or, as it is otherwise called, *Diffused aneurism*, or *Consecutive aneurism*) is produced by escape of blood from the artery, and its diffusion to a greater or less extent amongst the surrounding structures, according to their previous condition or anatomical arrangement. It may be the result of mechanical violence by strain or shock to the artery in a previously diseased condition; or of progressive disintegration of the sac of a circumscribed aneurism. In the latter case the diffusion of the extravasated blood is usually limited by antecedent adhesive inflammation of the surrounding parts, where, as in the transverse portion of the arch of the aorta, the position of the aneurism is favourable to that process. A case of this description recently came under the writer's notice. Under ordinary circumstances diffused false aneurism of the aorta cannot occur within the pericardium, owing to the isolation of that portion of the vessel, and the fragile structure of its serous investment. Hence, a yielding of the sac proper in this situation is, in most instances, followed by instant death from hæmorrhage into the pericardium and paralysis of the heart. In a few recorded cases, owing to previous adhesion of the pericardium, the patients survived rupture of the sac in this situation for several days.

Diffused false aneurism of the abdominal aorta is frequently formed by irruption of blood into the retro-peritoneal tissue, between the layers of the transverse meso-colon or the mesentery, or into the fibrous envelope of the psoas muscle. When the aneurism grows backwards the sac is quickly eroded by pressure against the vertebræ, the naked and carious surface of which then forms its posterior boundary. Diffusion in such cases rarely occurs until the vertebræ are entirely absorbed; the blood may then escape into the spinal canal, causing general paralysis and immediate death. Diffusion may also occur amongst the muscles and areolar tissue of the loins, or behind the diaphragm into either pleural cavity, usually the left. Any portion of the aorta outside the pericardium may be the seat of diffused false aneurism, but the transverse portion of the arch and the abdominal aorta are the parts most frequently affected.

Consecutive false aneurism, consisting in a primary bulging of all the coats of the artery, the internal and middle coats having subsequently given way, constitutes the ordinary form in which false aneurism originates: it therefore demands no further notice here.

c. Dissecting aneurism consists in a breach of the internal and middle coats, and a subsequent detachment of these from the external tunic, by the force of the blood-current, to a variable extent over the length and circumference of the vessel; or in a splitting of the middle coat by the same agency. This form of aneurism is of two kinds—that with a single aperture through which the blood enters the abnormal channel and returns to the artery; and that which exhibits two openings, one by which the blood escapes from, and another through which it re-enters the vessel. The former is the more usual variety of dissecting aneurism; and it is likewise the more grave, because liable at any moment to terminate fatally by rupture of the external coat.

Any portion of the aorta may be the seat of dissecting aneurism; the ascending part of the arch is most frequently affected, and next in the order of frequency comes the abdominal aorta. The primary lesion consists in a transverse rent of the internal and middle coats; when this is close to the heart, the outer or the anterior wall of the vessel is its usual site, and detachment of the tunics rarely extends beyond the ascending portion of the arch, and seldom engages more than a limited area of its circumference. In this situation, too, an aperture of re-entrance is rarely formed, the disease usually terminating by rupture of the external coat within the pericardium. When, on the contrary, the second curve of the arch, or any portion of the aorta beyond this point, is the seat of primary lesion, separation of the coats is usually found to extend along the remainder of the length of the vessel, and over the whole or greater part of its circumference, whilst the blood has re-entered through an opening in one or both common iliac arteries.

The establishment of a second aperture of

communication with the artery is an attempt at 'natural cure;' and when this happens the patient may survive for many years. Amongst the eccentricities of dissecting aneurism may be mentioned detachment of the laminated clot from the walls of the sac proper, and subsequent escape of blood by rupture of the latter; and separation of the mucous from the muscular coat of the œsophagus, with irruption of blood into the stomach. Dissecting and ordinary false aneurism may coexist, the former being usually a consecutive lesion, and the immediate cause of death.

d. Varicose or *Anastomosing aneurism* consists in a direct communication between an aneurism of the aorta and (*a*) one of the chambers of the heart; (*b*) the pulmonary artery or one of its branches; or (*c*) one of the venæ cavæ or innominate veins. This form of the disease is necessarily consecutive, and usually late as to the period of its development. In the great majority of recorded examples the primary aneurism was connected with the ascending portion of the arch, and in a large number it arose from one of the sinuses of Valsalva. The communication, with few exceptions, is formed with one of the chambers of the heart, the pulmonary artery, or the descending vena cava. Of the cavities of the heart, the right ventricle is most often implicated; next in order is the right auricle; then the left ventricle; and lastly the left auricle. The pulmonary artery and the descending cava have been frequently involved, as might have been inferred from their close relationship to the ascending aorta; the innominate veins in fewer instances, and only when the aneurism engaged the upper portion of the arch. An aneurism of the abdominal aorta has communicated with the inferior vena cava in a few cases. In the process of formation of a varicose aneurism of the aorta, the apposed surfaces are agglutinated by adhesive inflammation; and the composite septum is subsequently eroded by progressive absorption, or suddenly rent by the force of the arterial current. The immediate effects of communication are engorgement and increased tension of the receiving chamber or vessel; diminished blood-current and vascular tension in the aorta and its branches; and admixture of arterial with venous blood when the right side of the heart or one of the great veins is the seat of discharge. The special symptoms and signs by which the disease is characterised have direct reference to these results. Death has followed most rapidly in those cases in which the aneurism had established a communication with the pulmonary artery or the left auricle.

Effects upon the Left Ventricle.—Hypertrophy of the left ventricle cannot be regarded as a consequence of aneurism of the aorta. The association, when it exists, is accidental; hypertrophy depending upon antecedent or consecutive disease or inadequacy of the aortic or the mitral valves, chronic atheroma of the aorta, granular degeneration of the kidneys, or excessive functional activity.

Symptoms.—The symptoms of aortic aneurism may be discussed under the three heads of (*a*) Pain; (*b*) Excentric Pressure; and (*c*) Tumour.

Pain.—The pain of aneurism is of two kinds, *intrinsic* and *extrinsic*. The former is due to subacute inflammation and tension of the sac, and varies with intra-vascular pressure. It is dull, aching, and localised, and promptly alleviated by measures which depress the circulation or reduce local tension. Extrinsic pain usually arises from pressure upon adjacent nerves, and may be direct or reflex. This kind of pain has the characters of a diffused and aggravated neuralgia, being paroxysmal, and wandering to a greater or less extent over the back, chest, shoulders, arms, abdomen, and thighs. In the abdomen, when due to pressure upon the splanchnic nerves or tension of the solar plexus, it is of the most excruciating character. The extrinsic pain of aneurism may be fixed and boring. When of this character, it is usually located in the back, and arises from progressive absorption of the vertebræ.

Excentric Pressure.—The parts affected by the pressure of an aneurism, and the symptoms thereby developed, vary according to its situation and the direction of its growth. Parts which are exposed to counter-pressure, or are otherwise fixed, suffer most; whilst those which are flexible or moveable are less injuriously affected. The symptoms have reference to the respective functions of the organs or structures pressed upon; whilst their severity is in direct proportion to the importance of those functions, and the degree of pressure exercised. Structures subjected to the remittent pressure of an aneurism are slowly removed by absorption, but between the sac and the resisting surface union has been previously established by adhesive inflammation. Hence the sac itself is at the same time absorbed, and escape of blood will inevitably occur where further resistance is not presented. When serous cavities are laid open by this process, entrance is effected by a rent; and if the cavity be large, *e.g.* the pleura or the peritoneum, death by hæmorrhage, almost instantaneous, is the result; in case of irruption into the pericardium or the spinal canal, death occurs with equal rapidity from compression and paralysis of the contained organ. Communication with a mucous canal or with the cutaneous surface is effected by a process of sloughing, and bleeding occurs by 'leakage,' in variable quantity and at uncertain intervals, till the slough is finally detached, when death by copious hæmorrhage immediately ensues. The irruption of an aneurism into a gland-duct, such as the ureter or one of the biliary passages, is fatal by obstruction and suspended secretion, the duct and its tributaries having been blocked by coagulum. Communication with the thoracic duct proves slowly fatal by inanition; and when an opening is effected into a vein, a varicose aneurism, characterised by special symptoms and signs, and of greater or less gravity according to its situation, will be the result.

The symptoms of nerve-pressure vary according to the nerves affected. Thus, pressure upon the roots or branches of sentient nerves is attended with neuralgic twinges or paroxysms referred to the seat of their peripheral distribution, and, when the pressure is extreme, with numbness in the same situation. Irritation of motor nerves is indicated by spasm or paralysis,

according to the degree of pressure, of the muscles supplied by them. Irritation of the cervical sympathetic, or of its cilio-motor roots, is revealed by dilatation of the pupil on the corresponding side: or, if the pressure be such as to cause paresis, by contraction of the pupil with ptosis, hyperæmia, hyperæsthesia, and elevation of temperature in the eye and corresponding side of the face. The effects of pressure upon the pulmonic and cardiac plexuses have been less precisely determined, owing to the difficulty of distinguishing the symptoms due to this cause from those which arise from direct pressure upon the trachea or bronchi, the great vessels, or the heart, or from structural disease of the heart or the coronary arteries: but that the paroxysms of bronchial spasm and of angina, so often witnessed in connection with aneurism of the arch of the aorta, are in some degree dependent upon pressure on the pulmonary and cardiac nerves, and occasionally are due to it exclusively, the writer entertains no doubt. The symptoms arising from the pressure of an aneurism upon the pneumogastric or recurrent nerve of either side have reference to the larynx, and are eminently characteristic. They are of two kinds, according to the degree of pressure; namely, those due to spasm, and those to paralysis, of the laryngeal muscles on one or both sides. They are presented under the several forms of dysphonia, aphonia, stridor, metallic cough, and paroxysmal dyspnœa. The latter is frequently of the most urgent character, and sometimes is the immediate cause of death.

Adjacent organs, such as the heart, lungs, liver, and kidneys, are occasionally displaced by an aneurism, the direction being determined by that of the pressure, and in part also by the direction in which the organ is moveable. Obstruction or occlusion of adjacent arteries, as indicated by diminished or suppressed pulsation, may likewise result from the pressure of an aneurism. Pressure on a vein is evidenced by venous stasis distal to the seat of obstruction; upon the pulmonary artery, by engorgement of the right chambers of the heart and general venous congestion. Obstruction or occlusion of either bronchus or of one of its primary branches is evidenced by distress in breathing or shortness of breath; and by diminution or suppression of respiratory sound in the corresponding portion of the lung. Inasmuch as the symptoms of excentric pressure may be produced by a tumour of any kind, they possess, in regard to aneurism, a diagnostic value only correlative to other and more positive evidence of that disease.

Tumour.—The tumour formed by an aneurism of the aorta is fixed, smooth, and compressible. It is alternately tense and soft in unison with cardiac pulsation, and is especially characterised by a movement of general and equal expansion, synchronous with the impulse of the heart. It is further distinguished by a remarkable liability to vary in the rate and direction of its growth, retrocession at one point coinciding with enlargement at another; a new set of symptoms being at the same time developed by its encroachment upon fresh territory. In the progress of cure the tumour may become solid, incompressible, and uneven, by deposition of laminated fibrin within the sac.

Physical Signs.—The physical signs of aneurism of the aorta are those which may be elicited by *palpation*, *percussion*, and *auscultation*. They supply the most valuable, and, indeed, the only positive evidence of the disease.

Tactile signs.—The tactile signs of aneurism, *impulse*, *fremitus*, and *remittent tension*, are contingent on perceptible tumour. The impulse may be single or double. It is most frequently single, and is then always systolic in rhythm, coinciding approximately with the impulse of the heart. In character the systolic impulse is heaving and expansile; and it is diffused, in most instances equally, over the entire tumour. It is due to sudden expansion of the sac from active influx of blood during ventricular systole: hence, in those portions of the aorta which are close to the heart, it is synchronous with the apex-pulsation; but in the descending-thoracic and abdominal aorta perceptibly post-systolic in time. The force of systolic impulse and the expansion of the sac will be directly as the contractile power of the left ventricle, and inversely as the deposit of coagulum within the sac. A second and more feeble impulse of diastolic rhythm is occasionally, but much less frequently, exhibited by an aortic aneurism. This is the 'back-stroke,' or 'impulse of arrest' of authors. It coincides with the first period of ventricular diastole and the second sound of the heart, and is due to asynchronism of reaction between the aorta and the sac—that of the latter being notably later, owing to its defective elasticity. The consequence is a sudden arrest to the recoil of the sac by influx from the aorta. Diastolic impulse is therefore eminently characteristic of aneurism.

Fremitus or thrill is of more frequent occurrence than diastolic impulse, and, when not communicated from the heart, no less distinctive of aneurism. It accompanies the systolic impulse, and is due to the vibration of a thin sac from an eddy in the current of influx, produced either by a spiculated condition of the orifice, or by a pendent flake of fibrin.

Percussion-sound.—The intrinsic percussion-sound of aortic aneurism is absolutely dull to the extent of the tumour. Posteriorly the dulness is not sufficiently distinguishable from that of the vertebral column and muscles to be of positive diagnostic value; whilst laterally and in front, when the tumour is not in actual contact with the walls of the thorax or abdomen, it is modified or masked by the intervention of the lung or the intestinal canal. Under any circumstances, dulness *per se* cannot afford positive evidence of aneurism, inasmuch as it may be due to a tumour of any kind, solid or liquid, in the same situation; but, the presence of a tumour having been determined, the shifting of percussion-dulness from one point to another, or its cessation where it had been previously detected, would be in the highest degree suggestive of aneurism.

Acoustic signs.—These are *tone* or *sound*, and *murmur*. *Sound* without murmur is of frequent occurrence in aneurisms of the arch, but comparatively rare in those of the descending-

thoracic and abdominal aorta. It is usually double, corresponding in time to the sounds of the heart, but exaggerated, the second aneurismal sound being especially intensified. The first sound is occasionally 'splashing,' and both are not unfrequently of a 'booming' quality, —characters no doubt due to the density, rigidity, and great capacity of the sac.

The *murmur* of aneurism is most frequently single, systolic, and blowing; it is occasionally double (systolic and diastolic); and still more rarely single and diastolic. As to quality, the systolic murmur may be accompanied by a musical note, 'cooing,' or shrill, and audible over the whole or only a portion of the tumour. Lastly, it may be, and usually is, of a 'buzzing' character in cases of varicose aneurism. The essential cause of the murmur of aneurism consists in friction of the blood against the orifice, and the production of an eddy or a 'fluid vein' within the sac. A certain force of ventricular contraction is, however, likewise necessary. Hence the not unfrequent coincidence of cessation of murmur with failure of the left ventricle for some time before death. A strongly contracting ventricle, a relatively small orifice, a capacious sac, and a liquid state of its contents, supply the most favourable conditions for the production of murmur. The orifice of entrance need not be absolutely narrow; a large fusiform aneurism, even of the true kind, with rough walls, and containing liquid blood, may yield a loud systolic murmur, as the writer has frequently witnessed. A murmur may be absent in an aneurism lined by thick laminæ of fibrin through which there is a smooth channel, or in a lateral aneurism communicating by a small orifice with the vessel.

Diagnosis.—The positive diagnosis of aneurism of the aorta may be made from the existence of a tumour, forming a second centre of pulsation and of sound; the pulsation being systolic, expansile, and equally diffused over the tumour, accompanied by thrill, and succeeded by a minor pulsation of diastolic rhythm; whilst the sound, single or double, and accompanied or not by murmur, is always sharp and ringing, and occasionally of a 'booming' quality. The foregoing signs are rarely all associated in the same case. Various other groupings of rational symptoms and signs would be scarcely less conclusive as to the existence of aneurism of the aorta. General systolic expansion, thrill, diastolic impulse, and exaggerated sound, at a point more or less distant from the heart, constitute the most positive signs of the disease.

The existence of aneurism of the aorta may be inferred with greater or less confidence from certain symptoms and signs, according to their individual or correlative value. Even negative signs, if associated with others in themselves of minor significance, may be scarcely less conclusive than the most positive evidence would be. Thus, for example, suppressed respiration with percussion-resonance on the left side of the chest, dyspnœa, hæmoptysis, fixed pain in the back, and left intercostal neuralgia—the entrance of a foreign body into the left bronchus and the existence of cancer of the posterior mediastinum having been excluded—would be all but conclusive as to the existence of aneurism. A foreign body in the bronchus might be diagnosed from the history of a misadventure in swallowing, followed immediately by dyspnœa, hæmoptysis, and the special signs of bronchial obstruction, which, in nine cases out of ten, would be on the right side: whilst the diagnosis of mediastinal cancer would rest upon evidence eminently suggestive, namely, the presence of cancerous enlargements in the neck and axilla, and of extreme dulness over the root of the lung, without corresponding pulsation or sound. Finally, aneurism of the aorta may be, though it very rarely is, strictly latent in regard to both symptoms and signs.

Prognosis, Duration, and Terminations.—The prognosis of aortic aneurism is in the highest degree unfavourable. Recovery is, however, under favourable circumstances and appropriate treatment, quite within the range of medicine. Numerous examples of cure of aortic aneurism, both thoracic and abdominal, have been lately recorded.

The duration of life, in connection with aneurism of the aorta, has varied, according to the experience of the writer, from ten days to eleven years; but it may be much longer. The situation and relations of the aneurism; its complications; the constitution of the sac, and the state of its contents; the previous health and present habits of the patient; and the advantages enjoyed in regard to rest and treatment—will all materially influence the prognosis, whether as to duration of life or prospect of recovery.

Death in aneurism of the aorta may result from —(*a*) rupture of the sac; (*b*) exhaustion from pain, loss of sleep, or leakage of blood; (*c*) asphyxia; (*d*) syncope; (*e*) inanition; or (*f*) intercurrent disease. The foregoing represents the order of relative frequency of the several causes mentioned. Rupture of the sac is not, of necessity, immediately fatal. Hæmorrhage may be stayed, and life thus protracted for several days, by obstruction from the extravasated blood, itself arrested and coagulated in the surrounding tissues, or by its pressure upon the aorta on the proximal side of the sac. Rupture into one of the chambers of the heart, the pulmonary artery, either vena cava or the innominate vein, the portal vein, or the biliary passages, is usually fatal within a very brief period; whilst rupture into one of the serous cavities in the absence of previous adhesion, into the trachea or bronchi, or into the alimentary or the spinal canal, is instantaneously fatal.

Treatment.—The treatment of aneurism of the aorta is *palliative* and *curative*. Pain from nerve-pressure is most effectually relieved by hypodermic injections of morphia, one quarter to half a grain in solution, repeated and increased in quantity according to necessity. The pain and oppression due to congestion of the sac and the surrounding structures is best treated by local or general abstraction of blood, combined with the use of cardiac and vascular depressants, especially iodide of potassium (20 to 30 grains every fourth hour), chloral hydrate (20 grains), and veratrum viride or aconite (5 to 10 minims of the tincture every third hour). Mechanical support by means of a well-constructed shield is likewise

useful when the tumour projects externally. Fixed pain in the back, due to erosion of the vertebræ, is most effectually relieved by a seton or issue in the vicinity of its seat. The *curative* treatment of aneurism of the aorta may be classified under the heads of—(*a*) compression of the artery, proximal or distal; (*b*) distal ligature; (*c*) absolute rest with regulated diet; and (*d*) the use of medicinal agents promotive of coagulation within the sac. For the details of these several modes of treatment the reader is referred to the articles in this volume respectively intitled Aneurism, Abdominal Aneurism, and Thoracic Aneurism. Thomas Hayden.

AORTIC VALVES, Diseases of. *See* Heart, Valvular Diseases of.

APEPSIA (ἀ, priv., and πέπτω, I digest).—Indigestion. *See* Digestion, Disorders of.

APERIENTS (*aperio*, I open).—Medicines which produce a gentle action of the bowels. *See* Purgatives.

APHAGIA (ἀ, priv., and φάγω, I eat).—Inability to swallow. *See* Deglutition, Disorders of.

APHASIA (ἀ, priv., and φημὶ or φάω, I speak).—Synon.: *Aphemia, Alalia*; Fr. *Aphasie.*

Description.—Aphasia is the name given to a defect of speech from cerebral disease, to which much attention has been paid during the last few years. When it exists the patient is found to be unable to utter any proposition, though his occasional distinct pronunciation of some one or two words shows that his speechless condition is not due to a mere difficulty in the more mechanical act of articulation. Moreover, the patient's intelligent manner and gestures may plainly show that he understands what is said, and is capable of thinking, even though he is quite unable to give expression to his thoughts. This kind of powerlessness as regards speech is most frequently encountered in persons suffering from right hemiplegia, though it is occasionally met with in those who are paralysed on the left side, and at other times in persons who are not hemiplegic at all.

The aphasic condition is not always, as it ought to be, clearly distinguished from another which may be encountered in association with hemiplegia on either side of the body, and to which the name *Amnesia* is given. The essence of this latter defect lies in the fact that the patient very frequently substitutes wrong words or names in the place of those he wishes to employ, as when speaking of his 'hat,' he calls it a 'brush;' or when seeking a 'pen,' he asks for a 'knife.' In a bad case of this kind the patient may be quite unable to arrange words into a sentence capable of conveying a definite meaning, so that his speech is rendered unintelligible. Where this species of defect exists there seems to be an inco-ordinate action of those higher cerebral centres whose function it is to translate thought into the corresponding motor acts of speech, so that we get hesitation and delay in the utterance of right words, or, what is worse, the substitution occasionally of entirely wrong words or even of a meaningless set of sounds. These amnesic or inco-ordinate defects were not at first recognised as being distinct in nature from those of an aphasic type, in which there is rather a loss than a misdirection of power in some of the higher centres, whence the incitation to the motor acts of speech proceed. The two kinds of defects, indeed, not unfrequently coexist to some extent in the same individual.

When occurring in association with hemiplegia, aphasia varies much in intensity according to the degree of general mental impairment with which it may be combined. During the first week or ten days after the onset of such an attack the special defect may be scarcely recognisable, owing to the masking influence of the general mental impairment. The patient lies, perhaps, in a restless but otherwise lethargic state, taking no notice of what is occurring around him, and not allowing his attention to be fixed even for a moment; so that there is at such a time no positive ground for concluding that he or she will subsequently manifest aphasic symptoms. But where recovery of general mental power begins to show itself, and the patient taking notice of what is passing around him, also attempts to reply to simple questions, the first signs of an aphasic condition may reveal themselves. He perhaps says 'yes' or 'no' to all questions indifferently; or if both words are used, it is inappropriately. Even in this stage, however, there may be defective power in the initiation rather than in the execution of many much simpler acts than those of speech. Attention to the nature of this defective power clearly shows that it is not occasioned by paralysis in the ordinary sense of the term. Thus a patient in this condition may not be able to protrude his tongue when simply told to do so, though it may come out with much readiness when a sweetmeat is applied to the lips, or even when he is shown rather than told what we want him to do.

After a time, however, such a patient may regain a considerable amount of general mental power, though he may be left more or less hemiplegic, and may also present the aphasic defect to a marked degree. He readily comprehends everything that is said to him, and can often understand what he reads. But at other times, as was the case with one of Trousseau's patients, though able fully to understand when read to, he does not seem to understand when he himself attempts to read. He can, perhaps, play draughts or chess well, and by means of gestures and pantomime can make his wants and most of his wishes fairly well understood by those accustomed to interpret them. Yet he may only be able to articulate some one or two words, or else combinations of mere unmeaning sounds, such as 'poi, boi, bah,' 'sapon, sapon,' or some other sounds which, doing duty on all occasions, constitute his only form of speech. On rare occasions, under the influence of strong emotion, the patient may blurt out some simple expletive or short phrase, such as 'oh dear!' Sometimes he can repeat a word which he has just heard uttered, though at other times he has no such power, and may even be unable to repeat, when told to do so, one of the stock words or

sounds to which he is accustomed to give utterance. In a few cases the patient has seemed unable to understand what is said, as though from some difficulty in realising the meaning of words. Words may have to be uttered very slowly and repeated several times to such a patient, and even then they may fail to convey their meaning. Yet the language of gesture, appealing as it does to the sense of sight, may be at once understood.

The patient's power of writing is necessarily interfered with when aphasia, as is so often the case, co-exists with right hemiplegia. Many such patients, however, learn to write with the left hand to a variable extent, though others continue powerless in this respect. The variations as regards the power of writing are, in fact, almost as marked as the variations in power of speaking, though these two classes of defects by no means run parallel with one another in the same individual. The writer has known a man who was quite unable to express himself in spoken words, write a fairly good letter with very few mistakes; on the other hand, the performance of such a patient, without a copy before him, may be limited to writing his own name. At other times the patient is able to write only mere senseless combinations of letters; or writing some words correctly, he makes mistakes and substitutions with others—in fact, shows an amnesic defect in writing, and writes much as an amnesic patient speaks. Still more rarely it is found that an aphasic patient is, though not from want of manual power, unable to write even a single letter—in attempting to do so he makes mere unmeaning strokes.

Looking to the mode in which these symptoms most frequently group themselves, we find in one set of cases defects of an aphasic type only, as follows:—1. Loss of power, both of speaking and of writing (*Typical Aphasia*). 2. Loss of power of speaking, but power of writing preserved (*Aphemia*). 3. Loss of power of writing, but power of speaking preserved (*Agraphia*). At other times aphasic and amnesic defects are combined in the same individual, and then we may have—4. Loss of power of speaking, with an amnesic defect in writing. 5. Loss of power of writing, with an amnesic defect in speaking. Or, lastly, mere amnesic defects alone may exist in speech, in writing, or in both modes of expression.

Pathology. — The recent concentration of attention upon these defects of speech was started by the enunciation of Broca's views as to the dependence of the aphasic defects upon lesions in or about the third left frontal convolution. Subsequent investigations have in the main tended to confirm Broca's view as to the effects of injury to this convolution, though Meynert and others think that a lesion of the convolutions of the island of Reil on the same side is more frequently productive of aphasic symptoms. But all pathologists are now agreed as to the fact that lesions in or about the third left frontal convolution are much more prone to give rise to aphasic symptoms than are corresponding lesions on the right side of the brain. It is commonly believed, however, that amnesia may be induced by superficial lesions on either side of the brain, and by lesions also which vary much in their topographical distribution.

Aphasia occasionally supervenes, independently of paralysis or convulsions, in individuals who have been subjected to great excitement or prolonged overwork, when it may be due, perhaps, to mere functional derangements. In other cases it presents itself as a temporary condition, lasting only for a few hours or a few days, in a patient who has just had an attack of right-sided unilateral convulsions; or, lastly, as has already been indicated, it occurs in conjunction with a right-sided hemiplegia produced either by brain-softening or by cerebral hæmorrhage. Cases belonging to the latter category vary very much amongst themselves as regards the degree of co-existing hemiplegia. If the third left convolution alone is damaged by softening, the hemiplegic condition may be transient and incomplete—never, perhaps, affecting the leg appreciably. This condition is often induced by a small hæmorrhage, or by a patch of softening produced by an embolism of that branch of the middle cerebral artery which supplies the third frontal convolution; but where the hæmorrhage is larger, or where the main trunk of the middle cerebral artery is obliterated, either by an embolon or a thrombus, the aphasia is combined with much graver and more persistent paralytic symptoms.

In some cases in which typical aphasia is met with, no actual lesion of the third frontal convolution is discovered after death. This is due to the fact that these symptoms may be occasioned by a lesion which, whilst not implicating the third frontal convolution itself, severs or interferes with the efferent fibres proceeding from this convolution to the corpus striatum, the next lowest nerve-centre; so that a lesion either of the part of the corpus striatum in relation with the third frontal convolution, or of the white matter intervening between the two, should be, and is found to be, as capable of producing aphasia as a lesion of the convolution itself.

The third left frontal convolution is not now supposed, as Broca put it, to be the seat of any 'faculty of language,' though the anatomical investigations of Meynert and of Broadbent have shown that its relations with other convolutions are exceptionally complex. Whether or not certain assumed higher centres for speech are situated in this part of the brain, it must at least be conceded that this convolution is intimately concerned with the physical expression given to thought in articulate speech and in written language; it contains, in fact, the sites (or nerve-centres) from which the volitional incitations to these muscular acts usually pass downwards to lower centres.

We know that the left hemisphere is the one from which the volitional incitations proceed in the case of written language, and it is presumed that the same half of the brain also takes the lead in the production of articulate speech. It is, therefore, a point of much interest when we find that, in some of the exceptional cases in which aphasia has occurred in association with lesions on the right side of the brain and left

hemiplegia, the individuals had been left-handed during life. Some of the other exceptional cases, however, have not admitted of this interpretation, so that further observations are required.

TREATMENT.—Where aphasia occurs after excitement or overwork, without paralysis, it is a warning of much importance, since it may be the precursor of much graver symptoms. Under such circumstances the patient requires an absolute cessation from work for a time, and most careful watching. Stimulants may need to be diminished, and bromide of potassium, with sumbul and other sedative remedies, should be administered. Where aphasia is a temporary condition in association with right-sided convulsions, or where it is lasting and co-exists with right-sided paralysis, the treatment of the aphasic condition becomes merged in that of the associated convulsive tendency or paralytic condition, since, as a rule, an amelioration takes place in the patient's power of speaking coincidently with his improvement in other respects. This, however, is not always the case where aphasia has co-existed with a partial hemiplegic condition; the paralysis may be recovered from, whilst the aphasic defect remains more or less as it was. Where this is the case, an attempt should be made to teach the patient to speak again. Such efforts have occasionally been crowned with success (see *Trans. of Clin. Soc.*, vol. iii. p. 92), but much judgment and untiring patience have to be called into play in order to obtain satisfactory results. H. CHARLTON BASTIAN.

APHEMIA (ἀ, priv., and φημὶ, I speak). *See* APHASIA.

APHONIA (ἀ, priv., and φωνὴ, the voice).—Absence of voice, that is, of intonated utterance. *See* VOICE, Disorders of.

APHRODISIACS (Ἀφροδίτη, Venus).—DEFINITION.—Medicines which increase the sexual appetite and power.

ENUMERATION.—The direct aphrodisiacs include—Nux Vomica and Strychnia, Phosphorus, Cantharides; Urtication and Flagellation; Cannabis Indica, Opium, and Alcohol in small doses. Iron and bitter tonics; meat diet; warm clothing, especially around the hips and loins; and abstinence from severe mental and bodily work act as indirect aphrodisiacs.

ACTION.—Aphrodisiacs may act by increasing the excitability of the nerves passing to or from the genital organs, or of the genital centre in the spinal cord (*see* ANAPHRODISIACS), as, for example, strychnia, nux vomica, and probably phosphorus; by causing irritation of the nerves of the genital or urinary organs or of adjoining parts, as cantharides and urtication; or by stimulating the brain, as Indian hemp or small doses of opium. Alcohol in large doses has a double action, increasing the sexual desire by stimulating the brain, while lessening the power of erection, probably by weakening the nerves through which the spinal centre acts on the genital organs, or depressing this centre itself. As the sexual passion becomes diminished when the nervous system is weakened with the rest of the body, and increases with returning strength, iron with bitter tonics, and generous diet act indirectly as aphrodisiacs.

USES.—When the sexual functions are abnormally depressed, strychnia and phosphorus are the most generally useful of the direct aphrodisiacs. Cantharides, although sometimes valuable, must be employed with caution.

T. LAUDER BRUNTON.

APHTHÆ—APHTHOUS ULCERS (ἅπτω, to inflame).—SYNON.: Fr. *Muguet*; Ger. *Fasch.*

DESCRIPTION.—In some states of debility and deranged digestion the tongue, together with the other parts of the mouth, becomes studded with small flakes, like morsels of curd, which are known as *aphthæ*. Sometimes these flakes extend and coalesce, so as to form large patches of thick, soft fur. This condition is particularly apt to manifest itself at the extremes of life—in infancy and old age—but it also occurs in the later stages of wasting or debilitating complaints. The white flakes can easily be detached, but, if this is done, they are soon reproduced. It is better, therefore, not to detach them, but to aim at removing the conditions which are essential to their existence. If they are forcibly detached, they are apt to carry the epithelium along with them, and to leave the papillæ raw; and these raw spots are prone to ulcerate. *Aphthous ulcers* have a very characteristic appearance. They are small, flat, and circular or oval; generally occurring in clusters, and, as it were, in successive crops. Their bases are soft and smooth, with a thin yellowish or greyish slough; their margins are well-defined and surrounded by a bright red areola, without thickening or elevation. They are commonly situated on the fore part of the tongue and the lips, where they are always accompanied by increased heat, and vivid congestion of the mucous membrane. At the same time there is generally

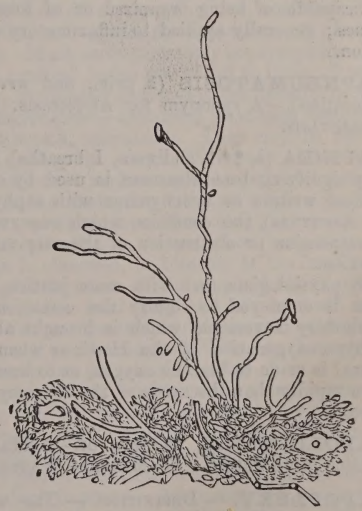

FIG. 1.—Oidium albicans.

active gastric or intestinal irritation, as well as fever of an atonic kind.

It was not till 1842 that the precise nature of these white patches was ascertained. In that

year it was shown by Gruby that they depend upon the presence of a microscopic fungus, to which he gave the name of *aphthaphyte*, or *cryptogame du muguet*. Subsequently this fungus was referred by Robin to the genus *oidium*, and by him called *oidium albicans*. It is found growing upon the tongue in close association with the epithelium. It forms delicate, horizontal filaments, which are apparently homogeneous in structure, and from which short articulated pedicels take their rise. The uppermost cells of these pedicels become expanded into oval bodies which fall off, germinate, and become new filaments. It is generally found growing in tangled masses, like minute bunches of mistletoe, mixed with the *débris* of scattered spores, cells of the *leptothrix*, and epithelial scales; but if separate filaments are followed out we may obtain such forms as those represented in Fig. 1.

Many ulcers are called aphthous which are really dyspeptic, and which owe their origin to stomatitis and irritation of the intestinal canal. The true aphthous ulcer, however, is always accompanied by the growth of the parasitic fungus that has been described above, and to such ulcers the term ought to be confined.

The *treatment* of this affection will be found described under THRUSH, a popular term which includes both aphthæ and the dyspeptic ulcers resembling them.

Some writers speak of *aphthous ulceration of the vagina*, by which is meant a severe form of vaginitis attended by the formation of small ulcers resembling the aphthous ulcers. The *oidium albicans* is frequently met with in the vaginal secretion. W. FAIRLIE CLARKE.

APHTHOUS.—A term applied to diseases in which aphthæ are present.

APLASTIC (ἀ, priv., and πλάσσω, I mould). —Incapable of being organized or of forming tissues; generally applied to inflammatory exudation.

APNEUMATOSIS (ἀ, priv., and πνεῦμα, respiration).—A synonym for Atelectasis. *See* ATELECTASIS.

APNŒA (ἀ, priv. and πνέω, I breathe), literally signifying breathlessness, is used by some medical writers as synonymous with asphyxia (*see* ASPHYXIA), the condition which supervenes on suspension or obstruction of the respiratory function.

By physiologists, and with more justice, the term is employed to signify the cessation of respiratory movements which is brought about by hyperoxygenation of the blood, as when an animal is made to breathe oxygen, or to breathe more rapidly than the needs of the economy require.

APOLLINARIS, Waters of.—Acidulous alkaline table-waters. *See* MINERAL WATERS.

APOPLEXY. — DEFINITION. — The word *apoplexy* means, by its etymology, a *striking from* (ἀπὸ, from, and πλῆξις, a striking), and was at first and is still chiefly used to signify sudden abolition of consciousness and power of motion, which, in common English, is also called *a stroke*. Cerebral hæmorrhage being the most frequent cause of this condition, 'hæmorrhage into the brain' and 'apoplexy' came to be used as synonymous expressions. Subsequently the effusion of blood itself was spoken of as *the apoplexy*, the word being used to designate the pathological condition causing the symptoms which it at first epitomised. Ultimately it was applied to a similar pathological state elsewhere, and thus hæmorrhages into the substance of the lung, the spleen, or the retina were, and still are termed respectively pulmonary, splenic, or retinal 'apoplexies.'

The term *cerebral apoplexy* is sometimes used to particularise hæmorrhage into the brain, but it is more commonly employed to denote an apoplectic condition depending on any cerebral lesion, and in that sense it will be here employed.

W. R. GOWERS.

APOPLEXY, CEREBRAL. — SYNON.: A Stroke; Fr. *Apoplexie*; Ger. *Schlag*.

DEFINITION.—Loss of consciousness, of sensation, and of voluntary motion, coming on more or less suddenly, and due to a morbid state of the brain.

This condition of *coma* is termed 'apoplectic' when of sudden or rapid onset. Loss of consciousness may be due to other causes acting directly on the brain, such as defective or excessive supply or altered condition of blood; but it is customary to include among the forms of *apoplexy* only that sudden loss of consciousness which is due to cerebral congestion, and to consider as *apoplectic states* only those which result from distinct toxæmia.

ÆTIOLOGY.—The apoplectic condition may be due (1) to the influence upon the brain of a poison circulating in the blood; (2) to a sudden cerebral lesion, such as hæmorrhage or vascular obstruction; or (3) to a sudden shock or other impression arresting the cerebral functions, but causing no visible alteration in the brain.

1. The toxæmic states in which apoplectic symptoms occur are those of uræmia, drunkenness, and poisoning by narcotics, as opium, &c. These are described elsewhere, and need be referred to in this article only in respect to the diagnosis.

2. The great cause of apoplexy is a sudden cerebral lesion, which may be traumatic or may occur without external injury. Injury may lead to apoplexy by simple concussion, by laceration of brain, or by rupture of vessels and hæmorrhage. Apoplexy, not due to injury, may be caused by congestion; by thrombosis or embolism; but especially by hæmorrhage. The latter is its most common and most efficient cause. Profound coma is rarely due to any other spontaneous cerebral lesion. A very small hæmorrhage may cause apoplexy.

3. Lastly, apoplectic symptoms may occur without obvious lesion of the brain. The coma which results from concussion, that which succeeds an epileptic fit, and that which, in the absence of any recognisable cause, has been called 'simple apoplexy,' furnish examples.

PATHOLOGY.—In all these cases the apoplexy is in relation chiefly to the extent and suddenness of the lesion. Roughly speaking, its occurrence may be said to depend on the suddenness, its degree on the extent of the cerebral mischief. But the occurrence of apoplexy depends sometimes

on the size of the lesion, and the degree varies not only directly with the extent of the mischief, but with the extent of brain-tissue which is exposed indirectly to the irritative influence of the primary lesion. Hence position of lesion has an important influence in determining the apoplectic symptoms. For these several reasons apoplexy is especially profound when the hæmorrhage affects both hemispheres, either by simultaneous extravasation on each side, or as the result of hæmorrhage into the lateral ventricles.

The precise condition on which the apoplexy is immediately dependent has been a matter of dispute. It was formerly ascribed to the pressure exerted by the clot on the rest of the brain, either influencing directly the cerebral tissue, or pressing on and emptying its capillaries (Niemeyer). That such pressure is exerted by a large hæmorrhage is unquestionable. The convolutions on the side of the extravasation are flattened, and the falx is bulged to the opposite side (Hutchinson, Jackson). It cannot be doubted that the intensity of the apoplexy in these cases is due in part to this cause. But this will not explain the occurrence of the symptom in small hæmorrhages, by which no general pressure is exerted, or not more than is at once relieved by the displacement of the mobile fluid which surrounds the vessels. It will not explain its occurrence in laceration of the brain, or the early loss of consciousness in severe hæmorrhage, in which, as Jaccoud insists, it should, if merely due to pressure, be a late rather than an early symptom. There can be little doubt from these considera tions, and from the cases in which there is no recognisable brain-lesion, that shock is an important element in the causation of apoplexy. Thus in cerebral hæmorrhage the apoplectic symptoms are due in part to the influence on the rest of the brain of the irritation of the nerve-elements by laceration. We can thus understand why vascular occlusion causes a slighter degree of apoplexy, since the immediate irritation of the local anæmia is less than that of laceration; and also why lesions of the pons produce as they do such deep and long-continued coma, since the irritated fibres are connected with, and thus influence indirectly a large part of the cerebrum.

Simple Apoplexy was a term given by Abercrombie to the cases, once thought to be frequent, in which apoplexy occurs without recognisable brain-mischief or blood-poisoning. Some of these cases were probably instances of uræmic poisoning, and others may have been due, as Dr. Bastian suggests, to capillary embolism. But cases are not infrequent to which neither of these explanations applies, in which death occurs in an apoplectiform attack, all organs being found healthy, and the brain only exhibiting, in common with the other organs, that passive congestion which results from an asphyxial mode of death. The nature of these cases is still mysterious, but they may be grouped with those in which fatal coma follows an epileptic attack, and is apparently due to the brain-shock produced.

Serous Apoplexy is a term applied sometimes to cases of fatal apoplexy in which no lesion is discoverable except excess of serum on the surface of the brain. It is now understood that such serous effusion is met with constantly in atrophy of the convolutions, rarely in Bright's disease, and under no other circumstances. There is no reason for associating its presence with the apoplectic symptoms. The cases described under this term were probably instances of uræmia, or of 'simple apoplexy' in old persons with atrophied brains.

Symptoms.—The prominent feature of apoplexy is loss of consciousness without obvious failure of the heart's action. The onset is often instantaneous, so that the sufferer falls to the ground. The face may be flushed or pale—it is rarely very pale. The heart and arteries beat, often with undue force and lessened frequency. Respiration continues, but is laboured and stertorous, with flapping cheeks. The limbs are motionless. In severe cases no reflex action can at first be excited. The pupils may be dilated, contracted, or unchanged; in profound coma they are usually dilated; and they often vary in size spontaneously, being sluggish in their action to light. The patient can usually swallow, although often with difficulty. The sphincters permit the escape of urine and fæces, or the urine may be retained. In a case of moderate severity the reflex action soon returns, the conjunctivæ become sensitive, and the patient can be roused to exhibit some sign of consciousness, shows returning power of voluntary motion, opens his eyes when spoken to, and tries, when told to do so, to protrude his tongue. On the other hand, the apoplexy may continue or may deepen in intensity, the patient dying at the end of a few hours or a few days. Death rarely occurs in a shorter time than two or three hours. In very rare instances an extensive hæmorrhage into the pons or medulla may stop the respiration and kill the patient in a few minutes.

It is not often, however, that there is this simple loss of cerebral function, uniformly distributed, and gradually deepening or passing away. Much more commonly the symptoms of a local cerebral lesion are added to those of apoplexy. Frequently such symptoms precede the loss of consciousness—unilateral weakness, deviation of the mouth, convulsion. They may be recognised during the attack: the limbs on one side exhibit more complete muscular relaxation than those on the other; they fall more helplessly when raised; or there is unilateral rigidity or clonic spasm, unvaried in its seat; or inequality of pupils is observed, or rotation of the head and conjugate deviation of the eyes. As the patient recovers, these local symptoms become more and more distinct, the tongue deviates on protrusion, speech and swallowing are difficult, or the patient may have lost the use of language.

In *ingravescent* apoplexy the commencement of the cerebral mischief is marked by symptoms of general shock, without any, or with merely transient, loss of consciousness. There is commonly pain in the head, and there may be other localising symptoms. After some hours, during which the patient may continue his occupation, coma gradually comes on and deepens into death. This form of apoplexy, first described by Abercrombie, is usually due to a slowly increasing cerebral hæmorrhage.

The temperature in cerebral apoplexy is at first

always lowered, but usually the fall is small, and is succeeded, after twelve to twenty-four hours, by a rise.

Diagnosis.—From the unconsciousness due to cardiac *syncope*, apoplexy is easily distinguished. In the former the heart's action fails, the pulse is weak and imperceptible, the face is very pale, the respiration is sighing and irregular, reflex action is rarely abolished, and the sphincters are seldom relaxed.

From the several forms of *toxæmia* the diagnosis is often easy, sometimes extremely difficult. It is easy when, on the one hand, the symptoms of apoplexy are preceded or accompanied by those of a local cerebral lesion; or when, on the other hand, the direct or circumstantial evidence of poisoning is clear, or the symptoms of toxæmia unmistakable. Where there are no local symptoms, and where no guiding history is to be obtained, the diagnosis is difficult, but a correct opinion may commonly be formed by an attentive comparison of the symptoms present.

There may be, as just observed, indirect evidence of toxæmia: the breath may smell of opium or alcohol; the urine may contain albumin. But albuminuria or a smell of spirits may mislead. Cerebral hæmorrhage often occurs after drinking; spirit is constantly given to a person in a fit. A smell of spirit must therefore only be allowed weight in the absence of any evidence of cerebral mischief. So, too, albumin is always present in the urine in uræmia, but it is also very frequently present in cases of cerebral hæmorrhage. Alone, this evidence of Bright's disease is of little value, except there be general œdema and the patient be young; then uræmia is more probable than vascular degeneration and cerebral hæmorrhage. But with other symptoms which indicate uræmic poisoning, albuminuria is conclusive.

The age of the patient should be considered. Late life is in favour of brain-disease. The history of a fall or blow on the head adds weight to other symptoms of cerebral mischief.

The character of the coma will sometimes guide. In uræmia, and commonly in alcoholism, it is less profound than in cerebral mischief. The patient can readily be roused. In apoplexy, in opium-poisoning, and in the most intense alcoholic poisoning, the coma may be profound. On the other hand, in cerebral hæmorrhage the patient, as Dr. Hughlings Jackson remarks, may sometimes be roused to answer questions. Violent struggling is strongly in favour of drink.

The mode of onset of the coma is important. In apoplexy it is sudden; in uræmia slow. The uræmic patient becomes first drowsy, then comatose. But with convulsions uræmic coma may come on suddenly. The onset of the coma of opium- and alcohol-poisoning is also slow. In gravescent apoplexy is of deliberate onset, but a profound degree of coma is quickly reached.

General convulsions at the onset exclude drunkenness, and usually opium-poisoning, while they favour uræmia. Cerebral mischief sometimes commences with a convulsion, but the convulsion is then commonly unilateral, and one-sided symptoms are almost always afterwards to be recognised. Rigidity of limbs or local muscular twitching during the coma is, if constant in seat, in favour of cerebral mischief; if variable in position, it is in favour of uræmia (Reynolds). Post-epileptic coma is of course preceded by a convulsion, and should be borne in mind.

The state of the pupils is alone of little importance. Great contraction occurs in and suggests opium-poisoning, but it is present in hæmorrhage into the pons Varolii. The pupils may be normal or dilated in uræmia, in alcoholic or opium-poisoning, and in apoplexy. Inequality of pupils, an unilateral symptom, points to brain-mischief. The retina should be examined, since the presence of albuminuric retinitis points, in the absence of the signs of a localised cerebral lesion, strongly to uræmia.

Lastly, the temperature should be noted. In uræmia there is persistent uniform depression; in cerebral lesions the initial depression is succeeded by a rise to a point above the normal.

The diagnosis of the *cause* of cerebral apoplexy will be described more fully under the heads of cerebral congestion, hæmorrhage, and softening. It may be here pointed out that slight and transient apoplexy, without local symptoms, with flushed face, and coming on during effort, points to cerebral congestion; slight and transient apoplexy with marked local symptoms points to softening; early and profound loss of consciousness to cerebral hæmorrhage. Post-epileptic coma may be distinguished by the history of epileptic attacks; or, if this be not forthcoming, it may be suspected if symptoms of local cerebral lesion or indications of toxæmia are absent, if the patient be under 40, and exhibits indications of speedy recovery. 'Simple apoplexy' cannot be diagnosed during life, since freedom from the symptoms of a local lesion does not afford ground for inferring that there is no such lesion.

Prognosis.—The prognosis in cerebral apoplexy depends in part upon the intensity of the attack. As long as unconsciousness is complete, and reflex action abolished, the patient is in danger of speedy death. The longer the apoplectic condition lasts without improvement, the less prospect is there of recovery. Persistent depression of temperature, or a rise of several degrees above the normal after an initial fall, are both of grave significance: such cases rarely recover (Charcot, Bourneville).

The nature, extent, and position of the cerebral lesion, when they can be inferred, furnish other prognostic indications. In hæmorrhage the prognosis is more serious than in softening. A sudden occurrence or increase of apoplectic symptoms, a few hours or days after a slighter attack, is always grave, indicating a fresh extravasation. If such apoplectic symptoms become profound and uniform, the prognosis is fatal, rupture into the ventricles or on the surface of the brain having probably occurred. If the localising symptoms point to a lesion of the medulla or pons, the prognosis is almost as unfavourable. Early return of consciousness and slight alteration in temperature are favourable signs. Previous cerebral disease renders the prognosis worse. Lastly, the prognosis must be influenced unfavourably by any impairment of the organic functions of circulation and respiration, whether independent of or due to the cerebral lesion.

Treatment.—The treatment of cerebral apoplexy must be guided by the indications of its cause. Where none can be obtained, it should be treated as cerebral hæmorrhage. Stillness is the most important condition. The patient should be moved as little as possible, but placed in the recumbent posture with the head slightly raised. The neck should be freed from constriction. If the extremities are cold, warmth may be applied to them; and cold to the head if there is local heat or flushing. Sinapisms to the neck and extremities sometimes seem to hasten the return of consciousness. The administration of stimulants should be regulated by the state of the heart. In thrombosis or embolism the heart should be kept up to the normal by very careful administration of alcohol, ether, or ammonia. In hæmorrhage it may be allowed to fall a little below the normal, but indications of failing power should be watched for and counteracted. Where no causal indication exists, the latter is the wiser plan. Venesection and purgation are remedies of similar effect, but different in degree, and are indicated by high arterial tension and cephalic congestion, shown by incompressibility of the pulse and flushing of the face. Venesection is useful where the heart acts strongly, and the pulse is full as well as incompressible. Its effect is proportioned to the rapidity with which the blood is taken, rather than to the quantity removed. Purgatives remove serum from the blood, and lessen the amount of blood within the skull by causing an afflux to the capacious intestinal vessels. The best purgative is croton oil. With a failing heart and pale surface they should be avoided. Diuretics may then be used to relieve the vascular tension. As the apoplexy clears, the nature of the case becomes evident, and the treatment of the several conditions is described elsewhere. (*See* Brain, Hæmorrhage and Softening of.) For treatment of the other causes of the apoplectic state, *see* Alcoholism, Poisons, and Uræmia. W. R. Gowers.

APPENDIX VERMIFORMIS, Inflammation, Ulceration, and Perforation of.

Definition.—Inflammation of the appendix vermiformis from lodgment of hardened fæces or a foreign body, leading to ulceration, frequently ending in perforation of the coats; to inflammation and suppuration of adjacent tissues (perityphlitis); and to peritonitis, local or general.

Ætiology.—The usual cause of this affection is a foreign body (*e.g.*, fruit-pips or -stones, a small bone, shot, pins, &c.); or a fæcal concretion imprisoned within the cavity of the vermiform appendix. Perforation has been recorded in typhoid fever and tuberculous disease.

Anatomical Characters.—Before perforation takes place the appendix may be found distended with pus; a foreign body or concretion lodged within it; and the mucous membrane ulcerated. The concretion or concretions vary in size from a small pea to a bean; are usually brown and hard; and consist of layers of condensed fæces, secretions, and phosphates, deposited around a small nucleus, which may prove to be a seed or other foreign body, or a piece of unusually inspissated fæces. These concretions greatly resemble, and are often mistaken for fruit-stones. Ulceration and perforation may occur at any part of the appendix, usually, however, at the extremity or the lower third. There may be a circumscribed peritoneal abscess; or the perforated part of the appendix may be found adherent to the surrounding parts, for example the cæcum or the abdominal wall.

Symptoms.—Pain, generally ill-defined, in the right iliac region, may be the only symptom to attract attention, and, as a rule, it is not until local peritonitis or perityphlitis is set up that we may suspect the nature of the disorder; the absence of premonitory symptoms, of the characteristic tumour of typhlitis, and of intestinal obstruction, excluding inflammation of the cæcum. Often, however, the course from the first is latent, and the mischief is suddenly revealed by perforation into the peritoneum, followed by general and rapidly fatal peritonitis. Adhesions formed in front of the slowly advancing ulceration may localise the consecutive inflammation.

The substance imprisoned within the appendix may be dislodged by (*a*) inflammation and suppuration of the tissues around the cæcum (perityphlitis, pericæcal abscess); or (*b*) the appendix, at the point of perforation, having become adherent to the cæcum, a communication is established with this part.

Diagnosis.—Inflammatory affections of the cæcum and of the appendix can rarely be clearly distinguished from each other. Inflammation of the appendix is apt to persist, continuing to be acute and severe; while cæcitis may be subdued by free relief of the bowels. Cæcitis with ulceration is apt to follow intestinal inertia; while the alarmingly acute and rapidly fatal symptoms of inflammation with ulceration and perforation of the appendix often arise during perfect health. Inflammation of the cellular tissue surrounding the cæcum (perityphlitis) is more commonly the result of ulcerative inflammation of the cæcum than of the appendix. The complete investment of the appendix by peritoneum contributes to perforation and fatal general peritonitis.

Prognosis.—General peritonitis from sudden perforation into the cavity of the peritoneum is the great danger, recovery from which is extremely rare. Inasmuch as this may occur at any time during the course of ulcerative inflammation of the appendix, a guarded opinion should always be given when there is suspicion of the existence of this affection. Continued uneasiness in the right iliac region without indications of fæcal accumulation, or of inflammation in or around the cæcum, should not be regarded lightly. Though this serious accident is less apt to occur after the formation of adhesions around the advancing ulceration, we must not forget that well-marked local inflammation of the peritoneum, or of the cellular tissue around the cæcum, does not always prevent it, inasmuch as the adhesion which may thus form may not be sufficiently strong to withstand the pressure of pus in the appendix.

Treatment.—The patient must be kept at rest in bed, hot poultices applied, and an unirritating fluid diet allowed. Opiates, for the purpose of relieving pain and subduing the peristaltic contraction of the intestines, should be freely and continuously administered; and if irritability of

the stomach exist, they should be introduced by enema or by subcutaneous injection. Peritonitis or other complications must be treated as they arise. GEORGE OLIVER.

APPETITE.—In disease the desire for food may be either *lessened* or *increased*; or the appetite may be *perverted*, and a longing for various substances unfitted for or incapable of digestion may be displayed.

Loss of appetite — Anorexia accompanies almost all forms of acute or chronic gastritis; and as these affections constantly coexist with other diseases, great variety as regards the desire for food is manifested in various complaints. In acute gastritis there is often not merely a loss of desire for, but a positive aversion to food, and the patient resolutely resists any attempt at obliging him to take either solid or liquid nourishment. In the more chronic forms of gastritis the distaste for food may be only slight; in some cases the appetite is increased, but is quickly satisfied as soon as a small quantity of food is taken. In chronic ulcer of the stomach the appetite, as a rule, remains good, and the patient is only prevented from indulging it by the fear of the pain that will result from his so doing. Whenever the secreting structure of the organ is extensively diseased the appetite fails. Thus, in atrophy of the stomach the desire for food generally lessens along with the diminishing strength of the invalid. In cancer of the stomach there is always an extensive destruction of the glandular structure, and loss of the appetite is a constant and prominent symptom. It must be remembered that a loss of appetite may be more apparent than real. The physician is constantly consulted on account of this symptom, when a little inquiry will show that the patient is really digesting as much as his system requires, but that by a habit of eating without allowing a proper interval between his meals, or by indulging in food of too nutritious a nature, or in an undue amount of alcoholic stimulants, the sensation of hunger is prevented.

Increase of appetite—Bulimia usually occurs where there is a necessity for an increased supply of food. Thus it is common after all febrile diseases, where the stomach has been long inactive. Again, in diabetes, where a large portion of the food is passed off in the form of sugar instead of being converted into the material required to keep up the nutrition of the body, there is an unusually large appetite. A craving sensation is a common symptom in chronic catarrhal gastritis. It probably arises from the irritation set up by the mucus and fermenting substances long retained in the stomach, and is temporarily relieved by eating. The best treatment for such cases is to give alkalis about half an hour before the craving usually occurs, at the same time that the affection of the mucous membrane is combated by appropriate diet and remedies. In some persons the sensation of extreme hunger appears to arise from an irritable condition of the stomach, by which the food is passed into the duodenum before digestion is completed. The sensation is mostly complained of at night, and the writer has found it a good plan to let the patient have some beef-tea or meat lozenges, for example, either just before retiring to rest or during the night. In children a craving for food is a frequent symptom, and arises either from the irritation of worms, or from chronic catarrh of the mucous membrane of the small intestines.

Perversion of appetite—Pica is most common in pregnant or hysterical females. Curious articles, such as chalk, cinders, and slate-pencil, are sometimes swallowed. In the insane and in idiots articles of an indigestible nature are not unfrequently introduced into the stomach, such as string, paper, cocoa-nut fibre, &c.

It is a matter of great importance that all persons, but especially dyspeptics, should accustom themselves to control their appetite. Whenever a larger amount of food is taken than the stomach is capable of digesting, the residue is apt to ferment and thereby to produce gastric catarrh. This is more especially the case where the digestive powers have been enfeebled by previous attacks of gastric inflammation.

S. FENWICK.

APYRETICS. *See* ANTIPYRETICS.

APYREXIA (ἀ, priv., and πυρέσσω, I am feverish).—This word literally means absence of fever: it is also used to denote the interval between paroxysms of intermittent fever.

ARACHNITIS. — Inflammation of the arachnoid membrane. *See* MENINGITIS.

ARCACHON, West coast of France.—Summer and autumn resort. Sheltered by pine woods. Calm in winter. *See* CLIMATE, Treatment of Disease by.

ARCUS SENILIS is a crescentic opacity of the cornea, within its margin, often seen in old people. The arcus is usually first observed in the upper part, and soon afterwards a smaller opaque crescent, opposite to this, appears below. In the course of years the two crescentic marks become slightly wider and more opaque, their points having at the same time extended much more considerably in proportion, so that an *annulus* or ring is formed. It probably is always widest and most opaque above, and wider and more opaque below than at the sides. An arcus is grey when it first appears, but it may attain at last to an ivory whiteness. It is especially noteworthy that arcus, besides being regular in shape, of an evenly-graduated degree of opacity, and well-defined at its inner margin, is never continuous with the opaque sclerotic external to it, but is always separated from this membrane by an extremely narrow line of demarcation of unaffected corneal tissue, which, as it is normally almost transparent here at its margin, is the more conspicuous by force of contrast with the new opacity. At the same time it must be observed that the well-defined opacity is most opaque in the centre or slightly external to the centre of its width, at any part; so that, although it is everywhere well-defined, it is shaded off somewhat abruptly towards its outer circumference, and more gradually at its inner margin. The arcus is much more prone to increase in opacity than in width. It rarely attains a width, even at the upper part of the cornea, of more than $\frac{1}{8}$ in. It is very conspicuous when backed by a dark iris. The cornea within the regular boundaries of the arcus senilis remains perfectly transparent, and vision is in no degree impaired by it. Wounds

in the part of the cornea thus affected heal well, and no surgeon is led by it to operate in any other part of the cornea, rather than divide the arcus itself in the part in which the corneal opening is made in almost all operations on the eye.

Pathology and Ætiology.—Arcus senilis is essentially a fatty degeneration of the proper substance of the cornea. It is not fully explained why it should appear just where it does, so near to the source of nutrition of the cornea; the fatty substitute for the natural tissues seeming to occupy only the circumference, and first and chiefly under the upper and lower lid, where also the conjunctiva and sclerotic overlap the cornea more particularly—a situation in which the lids exercise a certain amount of pressure, which has been regarded by Dr. C. J. B. Williams as the immediate cause of the degeneration.

If an eye suffers from chronic deep-seated disease an arcus will develop more rapidly; as, for example, in a case of old recurrent iritis of one eye only, in which there was a well-marked arcus, while in the other there was hardly a trace of it. An anomalous case is that in which the upper and lower arcus are opposite as usual, but in an inclined meridian. Arcus senilis is as capricious in its appearance as other senile changes; it is no clear indication of the age, certainly not of the number of years of life of a patient, as it may appear even in youth, and may never appear even in extreme old age; but when it occurs before forty years of age it is taken, by some life-insurance medical officers, to be an indication of concomitant fatty disease of the heart and degeneration of the arteries. But fatty heart is often found without arcus, and arcus without fatty heart. If, together with other evidence of weakened heart-power, there be an arcus, it is probable that fatty degeneration of the heart exists.

Treatment.—Arcus senilis is incurable, and no one endeavours expressly to check its increase, which, no doubt, is sometimes possible, as the writer is acquainted with a case in which the successful treatment of Bright's disease has, for ten years, completely arrested its advance.

J. F. Streatfeild.

ARDOR (*ardor*, heat).—A sensation of heat, burning, or scalding, which may be felt along the urethra during the passage of urine (*Ardor Urinæ*); or in connection with the stomach (*Ardor Ventriculi*).

ARGYRIA (*ἄργυρος*, silver).—The slate-coloured stain of the skin produced by the internal use of the salts of silver. *See* Pigmentary Affections.

ARSENIC, Poisoning by.—Arsenic is classed as a metallic irritant poison, though its action is by no means limited to that of an irritant. It acts specifically on the gastro-intestinal mucous membrane, whatever be the channel by which the poison gains access to the system. The most usual source of acute arsenical poisoning is the administration of white arsenic or arsenious acid; but the sulphides, various arsenides, and impure commercial articles, such as dyes, wall-papers, and pigments, may be fertile sources of arsenical poisoning. Poisoning by arsenic may be either *acute* or *chronic*.

A. **Acute Arsenical Poisoning.**—This is the usual form of poisoning ensuing on the nefarious administration of any preparation of arsenic, but usually the oxide (*arsenious acid*) is employed.

Symptoms.—The symptoms do not, as in the case of corrosive poisoning, come on immediately after the administration of the poison. There is most commonly an interval of half an hour or an hour between the swallowing of the agent and the onset of prominent symptoms. The quantity of the noxious agent, and its state as regards solubility, have also an obvious relation to the commencement of symptoms. Most commonly, after a sense of faintness and depression, intense burning pain is felt in the epigastric region, accompanied by tenderness on pressure. Nausea and vomiting quickly supervene, increased by every act of swallowing. Unlike what occurs in an ordinary bilious attack, with which arsenical poisoning may be at first confounded, the pain and sickness are not relieved by the act of vomiting. The vomited matters are extremely varied, and present no characteristic appearances. At first they usually consist of the ordinary contents of the stomach, but at a later stage are largely charged with bile which has regurgitated into the stomach in consequence of the violence of prolonged emesis; and they may be tinged with blood. Ordinarily vomiting is speedily followed by violent purging, and great straining at stool, the motions being often streaked with blood. Purging may, however, be entirely absent. Other prominent symptoms are great thirst, a feeble irregular pulse, and cold clammy skin. The patient as a rule dies within eighteen to seventy-two hours in a state of collapse; but tetanic convulsions are not uncommon, and even coma and paralysis may close the scene.

Diagnosis.—From an ordinary bilious attack induced by improper diet or by decomposing food, arsenical poisoning is diagnosed by the persistence of the symptoms after the removal of the apparent cause; and not infrequently by the symptoms remitting and again supervening on the administration of food or drink of a particular kind, or given by a particular hand. From choleraic diarrhœa it is distinguished by the *sudden* onset of symptoms, thirty to sixty minutes after food or drink has been taken; by the absence of rice-water stools, or of lividity of the skin; and by the symptoms not yielding to treatment. Moreover, in poisoning by arsenic there is usually greater tenderness over the epigastrium; the diarrhœa is less passive, and accompanied with more tenesmus than in choleraic diarrhœa; the stools are more often bloody; and nervous symptoms may be more pronounced. The diagnosis is, however, often very difficult, except when aided by a chemical analysis of the matters ejected from the stomach or of the excreta, which should always be made in doubtful cases.

Prognosis.—This must always be uncertain, since it is rarely possible to ascertain the quantity taken, or to ensure its entire evacuation from the stomach.

Treatment.—Emetics, diluents, and demulcents are the appropriate remedies. The stomach-pump may also be usefully employed. In administering emetics, tartar emetic should be avoided, as it increases the depression, and its

presence complicates a chemical analysis. Moreover, tartar emetic frequently contains traces of arsenic, and, in the event of an analysis being made, an unfounded suspicion may be raised. No confidence can be placed in the so-called antidotes, *ferric hydrate* and *magnesia*, except where a solution of arsenic has been taken.

B. **Chronic Arsenical Poisoning.**—This form of poisoning is not uncommon, and is, unlike the acute form, generally accidental. The inhalation of arsenical vapours in factories, or of arsenical dust, as from green and other wall-papers, and in the process of manufacturing artificial flowers, is a common source of chronic arsenical poisoning.

Those who are chiefly exposed to this form of poisoning are persons employed in the manufacture of pigments, especially green pigments; paperhangers and decorators; artificial-flower manufacturers; milliners; persons exposed to the fumes of heated metals, particularly zinc and brass; manufacturers of dyes; and leather-dressers. In the process of depilating sheep-skins, previous to the tanning or the tawing process, a mixture of lime and orpiment (*sulphide of arsenic*) is used; and serious ulceration of the hands, scrotum, nose, and cheeks not infrequently results. Persons living in rooms the walls of which are covered with arsenical paper, especially bright-green papers containing arsenite of copper, are liable to suffer from chronic arsenical poisoning. It is uncertain whether this is entirely caused by the mechanical transfer of pigmentary dust to the air-passages, or is partly due to volatilisation of the arsenic, probably in the form of *arseniuretted hydrogen*. Many brown wall-papers also contain arsenic, and arsenious acid is sometimes added to the size; such papers have been known to produce the specific symptoms of arsenical poisoning.

That some persons can take arsenious acid internally with impunity in relatively large doses (*arsenic-eating*) is now a well-established fact.

Symptoms.—The first symptoms of chronic arsenical poisoning are usually loss of appetite, præcordial pains, irritability of the bowels, and occasionally headache. Suffusion of the eyes, a peculiar and characteristic appearance of the conjunctiva, often amounting to actual conjunctivitis, and intolerance of light are early manifested. The muscular power of the limbs is impaired pretty constantly, and actual paralysis extending upwards from the lower extremities is occasionally observed. A characteristic vesicular eruption on the skin (*eczema arsenicale*) is frequent, as well as irritation of the skin, especially over the neck, scalp, hands, and armpits. Males who handle arsenical preparations are liable to ulcerations of the scrotum and penis, obviously due to a mechanical transference of the poison to the genitals when these are touched. If the source of the disease be not removed, progressive emaciation, exfoliation of the cuticle, and nervous prostration supervene; and convulsions may precede the fatal termination. The effects of green arsenical pigments are sometimes manifested by bleeding from the nose.

Diagnosis.—When a patient suffers more or less from the symptoms above described, and is also known to be exposed to any of the sources of danger from arsenical poisoning enumerated under the ætiology, the diagnosis is not difficult.

Treatment.—The source of poisoning should invariably be removed. It is found that those who suffer from working in arsenic make no progress towards recovery until they are removed from contact with the poison. Wall-papers which contain arsenic, and are suspected to be the cause of symptoms, should be taken away. Quinine, or other tonics, iron, and attention to the digestive organs will be needed. Removal to fresh country air is often productive of marked benefit. Soothing lotions to the skin, and careful attention to eroding ulcers, especially of the cheek, may be necessary. Shampooing and warm baths form the best treatment for paralytic lesions.

Morbid Appearances.—These are the same by whatever channel the poison has gained access to the system. As a rule there is marked inflammation of the stomach and duodenum, usually of the small and large intestines also; but not uncommonly the inflammation is limited to the stomach, duodenum, and rectum, the intervening alimentary tract having escaped. If the poison has been administered in a solid form, white patches of the arsenical compound may be found imbedded in thick bloody mucus and inflammatory exudation. Portions of the white arsenic are also sometimes converted by the sulphuretted hydrogen evolved during decomposition into the yellow sulphide. Ulceration of the stomach is rare, and perforation almost unknown. An ecchymosed condition of the heart is often observed; and fatty degeneration of the liver, as in poisoning by phosphorus, has been described.

T. Stevenson.

ARTERIES, Diseases of.—It is important to keep in mind the following anatomical facts in studying the morbid processes to which arteries are subject:—In immediate contact with the blood-stream in arteries lies the *endothelium*—a layer of flattened cells; outside this is the *tunica intima*, composed of elastic tissue in longitudinal arrangement: together the endothelium and tunica intima constitute the *internal coat* of the older writers. Still more external we find the *middle coat*, made up of muscular fibre arranged transversely, in the larger arteries mixed with elastic tissue; and, most external of all, the *external coat*, consisting of longitudinally fibrillated connective tissue.

1. **Acute Arteritis**, affecting a very limited portion of a vessel, and leading to ulceration, occasionally occurs. In some cases this has arisen from the irritation caused by an embolus, which, becoming detached from a cardiac valve, has blocked a distant artery; and Dr. Moxon has specially drawn attention to its occurrence in the aorta, when the ascending portion of the vessel has been exposed to the impact of a hard, freely moving vegetation on one of the segments of the aortic valve. Dr. Moxon has also described, under the designation *inflammatory mollities*, the occurrence of softening and swelling of the arterial tunics in circumscribed spots; which become flabby and inelastic, and ultimately bulge outwards and form aneurisms. He believes that this condition depends on a peculiar general state, and is the great cause of aneurism in young, hard-

working men. Except in these circumscribed inflammatory lesions, we do not meet with any condition of the arterial tunics to which the designation acute arteritis can be applied. Such a change has, indeed, been described, and the writer has seen the lining membrane of the ascending and transverse portions of the aorta of a bright vermilion hue, strongly suggestive of acute inflammatory change; but the best observers are now agreed in believing that this appearance arises from staining by hæmatin.

2. **Chronic Arteritis** has been described as pursuing a course different from the *endarteritis deformans*, which will immediately be noticed; and as causing thickening of the coats of the vessels, narrowing of their calibre, and absence of pulsation during life. As such, chronic arteritis appears to be a disease of extreme rarity. But, on the other hand, if it be considered as the first stage of atheromatous disease, it may be said to be of frequent occurrence.

3. **Periarteritis** is the term applied by Charcot and Bouchard to the morbid change which, in their opinion, eventuates in cerebral hæmorrhage. According to these physicians, cerebral hæmorrhage is not usually due to atheromatous decay of the vessels of the brain; but, in the vast majority of cases, to the rupture of miliary aneurisms, which in their turn have been produced by a morbid process beginning in the perivascular sheath surrounding the cerebral vessels; and which, proceeding from without inwards, ultimately involves all the coats of the vessels (*see* Brain, Hæmorrhage into).

4. **Atheromatous Disease**, the *Endarteritis deformans* of Virchow, is the arterial disease which is most frequently met with, and the one whose consequences are most serious. It presents three tolerably well-defined stages. (*a*) In the *first* stage we notice, when the vessel is slit open, greyish patches, by which the lining membrane is irregularly thickened; these patches seem to lie on the surface of the membrane, but this appearance is deceptive; the endothelium lies between them and the blood-stream, and is, at least at the beginning of the morbid process, unaffected. The material of which the patches are formed is really situated between the tunica intima and tunica media; it is semi-cartilaginous in consistence, and is formed by an abnormally rapid multiplication of the deeper cells of the tunica intima,—the new growth pushing up this tunic with its super-imposed endothelium, and so causing a bulging into the interior of the vessel. The process is of the nature of an inflammatory change; that is, it consists in the proliferation of cellular elements, in consequence of some influence which has excited them to unnatural growth. (*b*) In the *second* stage the cellular elements of which the new growth is composed undergo a process of fatty degeneration; and in consequence it becomes yellowish in colour and pasty in consistence: it was the paste-like appearance of the mass in this stage which originally gained for the process the designation *Atheroma* (ἀθήρη = meal). It not unfrequently happens that the whole of the internal coat with its endothelium is involved in the softening, and gives way under the pressure of the blood, leaving an excavation, the floor of which is formed by the middle and external coats of the artery. (*c*) In other instances, however, the pasty mass, instead of being washed away, becomes the seat of calcific deposit. This is the *third* stage in the process. The appearance of a vessel in which atheromatous disease has reached this stage is very striking: plates which present to the naked eye the appearance, but do not show the minute structure of bone, are observed at intervals in the walls of the vessel, and their sharp spicula project into its interior; in the aorta it is not uncommon to find such plates an inch long and half an inch broad, and in the smaller arteries the calcific matter sometimes forms a ring round the vessel. In the latter the calcareous particles appear to be deposited in the patch while it is still firm, so that the second stage of the process is wanting.

Atheromatous disease sometimes invades both the aorta and the small vessels, but the aorta may be extensively diseased and the small arteries unaffected; or, on the other hand, the cerebral, temporal, and coronary arteries may be the seat of calcific change while the great vessels are healthy; occasionally the disease is limited to a few vessels. Next to the aorta, the cerebral, coronary, and splenic vessels, and the arteries of the lower extremities, are prone to this form of arteritis.

Effects.—The dangers to which an atheromatous state of vessels exposes the person in whom it exists are varied. The stream of blood is retarded by the projection of the new growth into the vessel, and still more by the destruction of the elasticity of its coats; and hence ensues a failure in the nutrition of the organ which depends for its supply of blood on the diseased vessel:—this is said to be a cause of cerebral softening. When the paste-like mass is washed away it sometimes happens that the blood insinuates itself between the coats of the vessel, producing a dissecting aneurism; or the portion of the vessel, which has been weakened by the removal of the internal coat, yields to the pressure of the current, and a sacculated aneurism is originated; sometimes the diseased vessel bursts. Cerebral vessels, probably on account of the thinness of their walls, are specially liable to rupture when they are the seat of atheromatous change; and occasionally a diseased coronary artery has given way, filling the pericardium with blood. Arteries have been completely occluded by the deposition of fibrin on the spiculated edges of calcareous plates: this is one of the causes of senile gangrene; and embolic plugging of distant vessels at times results from the detachment of such fibrinous clots, and the washing away of atheromatous débris. Rigidity of the larger arteries from atheromatous change is likewise one of the most frequent causes of hypertrophy of the left ventricle of the heart, on which increased work is imposed in consequence of the destruction of the elasticity of the vessels. Anasarca has not, so far as the writer is aware, been mentioned by any author among the consequences of diseased arteries; but some cases which have come under his observation have led him to the conclusion that persistent anasarca, especially of the lower extremities in elderly men, is sometimes mainly due to a diseased condition of the arterial tunics. In the cases which he has observed there was

likewise present dilatation with hypertrophy and commencing fatty change of the left ventricle, itself a consequence of the arterial disease; but this seemed insufficient to account for the persistent œdema of the lower extremities.

Ætiology.—The cause of endarteritis deformans is now generally admitted to be overstrain of the vessel. It was formerly thought that syphilitic impregnation of the system was a powerful favouring condition; but this opinion rested chiefly on observations made among soldiers, who, in addition to the syphilitic taint, were subject to other influences now known to be adequate in themselves to develop the disease: and the writer has himself seen the most extensive atheromatous disease in men in whom there was no trace of the syphilitic taint. Intemperate habits and gout appear to be powerfully predisposing causes; they probably render the blood impure, and its passage through the capillary vessels being thereby retarded, the tension of the arterial system is increased. Besides violent exertion, which imposes a strain on the entire arterial tree, there are other influences which act upon certain vessels. Thus the renal arteries are kept over-full in the cirrhotic form of Bright's disease, owing to the destruction of the capillary tufts, and hence atheroma of these vessels is almost constantly present in that form of renal mischief. The writer has on two occasions found extensive calcareous formations in the cerebral vessels of persons in whom cerebral degeneration had followed excessive anxiety and mental effort. The pulmonary artery is very rarely invaded by atheroma; and only in cases in which it has been kept in a state of tension by hypertrophy of the right ventricle or disease of the mitral orifice.

Diagnosis.—The diagnosis of atheromatous inflammation of the aorta will be discussed in a separate article. The existence of the disease in the arteries of particular organs can only be a matter of reasonable presumption when the patient is past middle life; when the ascertained causes of atheroma have been in operation; when symptoms of impaired nutrition of the organ are present; and when the organ (the brain or heart) is one the arteries of which are known to be prone to the disease. Calcification of the superficial arteries renders these vessels rigid and tortuous; the temporals when so affected attract the eye by their prominence, and may be felt hard and rigid beneath the finger; the brachial may equally be made the subject of examination; and, although the presence or absence of atheromatous change in such superficial vessels does not necessarily prove that the other arteries of the body are in a similar condition, it renders it more than probable that they are. Those who are not familiar with the resisting feel of the radial artery, when it is the seat of the change now under consideration, are liable to form a very erroneous estimate of the strength of the pulse: this may convey to the inexperienced finger an impression of a force which it does not possess. The error also is sometimes committed of inferring the existence of aortic regurgitation in these cases in consequence of the tortuous course and visible pulsation of the superficial vessels; but they do not collapse suddenly under the finger, as do the vessels during the receding wave in aortic patency. The sphygmographic tracing, moreover, is essentially different: in atheromatous disease of the artery the upstroke is vertical, and the summit of the tracing extended. The existence of such evidences of vascular mischief affords a fair subject for consideration to those who are called upon to form an opinion as to the eligibility of a life for assurance.

Treatment.—The treatment of endarteritis deformans is mainly preventive. It consists in the avoidance of all those influences to which we have adverted as causes of the disease, namely, indulgence in alcohol; causes originating a gouty state of the blood; excessive muscular efforts, especially in constrained positions; postures which involve the long-continued contraction of muscles which surround arteries; and, as far as the brain and heart are concerned, all those states which favour overfulness of their respective arteries:—in the case of the brain, excessive mental application, deficient sleep, and, the writer believes, prolonged periods of sexual excitement; in the case of the heart, *inter alia*, efforts which involve holding the breath, thus leading to distension of its right cavities, and imposing an obstacle to the return of blood from its walls.

5. **Fatty Degeneration**, unconnected with the atheromatous process, is sometimes, though rarely, found to affect arteries. Circumscribed opaque and velvety spots appear on the surface of the intima, and erosion ultimately occurs. Once this has taken place, the muscular coat, unable to bear the pressure of the blood-stream, fissures transversely; and the blood either ruptures the external coat, or, insinuating itself between the middle and external coat, produces a dissecting aneurism. This change has been found in the arteries of persons who seemed otherwise quite healthy; it is 'a morbid change which is simply degenerative from the first, and of whose immediate cause we know nothing' (Rindfleisch). Fatty degeneration of the external coat of the smallest arteries has also been noticed: it appears to be a senile change, and to play a part in the production of cardiac and cerebral degeneration.

6. **Calcification** of the arterial tunics also occurs unconnected with endarteritis, but more rarely than fatty degeneration. When this is the case, it is the middle coat of the smaller vessels that is the seat of the deposit, which consists of carbonate and phosphate of lime and magnesia. The process is usually limited to the vessels in which muscular fibre is abundant; but these it may affect extensively, the superficial vessels and the arteries of the brain and of the extremities being the favourite seat: it is eminently a senile change.

7. **Gummatous Disease** of the cerebral arteries in syphilitic patients has been described by Dr. Hughlings Jackson, Dr. Wilks, and others. The vessels present nodose swellings, and are thickened sometimes to three times their normal size by gummatous material infiltrating the outer coat; the calibre of the vessels is thereby narrowed, the formation of thrombi favoured, and cerebral softening produced. 'A random succession of nervous symptoms,' to use the words of Dr. Jackson, affords strong grounds for sus-

pecting syphilitic disease within the cranium; and the writer has himself seen three cases in which such symptoms disappeared under the use of perchloride of mercury and iodide of potassium, and in which it seemed to him that the supposition of arterial disease was much more probable than that of any other form of intracranial syphilis.

8. **Albuminoid Disease**, when it attacks the spleen or kidneys, appears first in the walls of the small arteries of these organs, but is not found in the larger arteries of the body.

9. **Contraction** and final impermeability of an artery from atheromatous calcification, from the accumulation of fibrine in its rough inner surface, from pressure, or from other causes, occasionally occurs, leading to gangrene of the extremity which it supplied.

10. **Dilatation** of arteries is in the majority of cases due to previous disease of their coats; but sometimes in the aged the arteries are found dilated without any degeneration of their tunics being present,—a state of affairs which Rindfleisch suggests may depend on atony of the muscular coat, and in some cases may possibly be connected with deficient innervation.

11. **Aneurism** receives full consideration in a separate article. Here it is merely necessary to point out the ways in which atheromatous inflammation and the other morbid processes which have been described contribute to the production of dilatation and aneurism. In some cases the course of events consists in the washing away of the diseased patch of the intima; when the middle coat either dilates, or, by separation of its muscular bundles, undergoes rupture, and the external coat yields before the pressure of the blood-stream. In other cases the dilatation occurs, not at the point where the endarteritis has invaded the vessel, but nearer to the heart. At the affected point there is narrowing of the canal of the vessel, and loss of elasticity in its coats; and as a consequence we have slowing of the circulation and deficiency in the supply of blood beyond, and increased arterial tension on the proximal side of the affected spot. The effect of this tension is more serious than would at first sight appear; in health the blood, propelled by each ventricular systole, enters contracted vessels, which, yielding before it, are uninjured by its sudden impact; but a vessel in a state of tension is exposed to the full violence of the column of blood discharged by the heart, and must gradually dilate before it.

12. **Arterial Disease in Insanity.**—According to Dr. J. Batty Tuke, and other physicians who have specially investigated the morbid changes in the brains of the insane, arterial disease is almost invariably present. It consists in such alterations as would result from obstruction in the ultimate ramifications of the vessels; —thickening of the proper coats of the arteries, and of the sheath of connective tissue which surrounds the cerebral vessels; the deposition of fine molecular matter and crystals of hæmatoidin between the adventitia and the sheath; and extreme tortuosity of the vessels.

13. **Arterio-Capillary Fibrosis** is the term applied by Sir William Gull and Dr. Sutton to the hypertrophy of the walls of the small arteries found in the subjects of the cirrhotic form of Bright's disease. It is admitted by all observers of repute that the walls of the blood-vessels of the kidney are greatly thickened in this malady; but it is by no means so universally admitted that the small arteries throughout the whole body are in all such cases similarly hypertrophied. That they are hypertrophied in a certain proportion of the cases admits of no doubt; but the nature of the thickening remains to be decided. Dr. George Johnson, who early called attention to this condition, considers that there is present an hypertrophy of all the tunics of the small arteries, especially of the muscular coat—a consequence of the obstruction which impure blood invariably meets with in the capillaries. Sir William Gull and Dr. Sutton, on the other hand, assert that the thickening is due to a fibroid growth, especially seated in the external coat of the vessel; and they believe that the coexisting disease of the kidney is not the cause of the arterial change, but that both are parts of a general diseased process. JAMES LITTLE.

ARTERIES, Examination of. *See* PHYSICAL EXAMINATION; and PULSE.

ARTHRALGIA (ἄρθρον, a joint; and ἄλγος, pain).—Pain in a joint. The term is more particularly applied to articular pain in the absence of objective disease.

ARTHRITIS (ἄρθρον, a joint).—A term generically used to signify any disease whatever involving a joint, but more correctly confined to articular inflammation. It is also employed to designate inflammation of *all* the structures forming a joint, as distinguished from mere synovitis. *See* JOINTS, Diseases of.

ARTHRODYNIA (ἄρθρον, a joint; and ὀδύνη, pain).—*See* ARTHRALGIA.

ARTICULAR RHEUMATISM.—Rheumatism affecting joints. *See* RHEUMATISM.

ARTIFICIAL RESPIRATION, or the method of exciting and keeping up the movements of the chest, so as to supply air to the lungs, is a subject of the highest importance, since the hopes of recovery depend on its due performance in many cases of narcotic poisoning, in the apparently drowned or asphyxiated, and in the collapse of the advanced stage of the condition induced by anæsthetics. For its effective employment it is essential to see that no foreign body obstructs the air-passages. Children and old people are liable to swallow large pieces of meat or crust, which become impacted in the pharynx or œsophagus. These should, if possible, be dragged away with the finger or a spoon-handle, but they may require the use of a probang. Tracheotomy is rarely necessary. A knife-handle held between the molar teeth is a ready and useful gag to keep the mouth open. A button-hook, in the absence of pharyngeal forceps, is sometimes very serviceable. Vomited matter should be quickly removed with a sponge or cloth twisted round a piece of wood. In treating the half-drowned the body should be inverted for a few minutes to favour the escape of water from the air-passages, but artificial

breathing should be commenced even whilst the body is in this position.

Methods.—In most cases the best method of commencing artificial respiration is to compress the chest and abdomen simultaneously, then remove pressure so as to allow air to enter the chest, and again repeat the pressure every two or three seconds. If the sound indicates that air is passing into and out of the lungs, this method may be continued for half a minute; but if we are not sure that the air is exchanged, and in all cases if the patient's condition is not decidedly improved in half a minute, we should resort to:—

1. *Sylvester's method.*—Place the patient on his back on the floor, with a block or pillow under his shoulders, and raise the arms upwards above his head, by grasping them above the elbow, and pulling firmly and steadily as long as there is any sound of air entering the chest. Some arrangement is needed to prevent the body from being dragged towards the operator. For this purpose the plan of raising the chest on a high cushion or box has been adopted, but as a condition of cardiac anæmia is often present, this is objectionable. It is better to effect the object by placing a book in front of the thighs while kneeling at the head of the patient. It may be needful to draw forth the tongue, but generally if the head falls back over a cushion placed behind the neck, this is not required. An artery forceps, or a noose of string, or a handkerchief will enable an assistant to keep the tongue well forward.

As soon as the sound produced by the entrance of air into the chest ceases, the arms should be brought down a little towards the front of the chest, and pressed firmly and steadily against it for about one second after air is heard escaping. In cases of drowning it is enough to repeat this operation every four seconds, but in the collapse resulting from chloroform or other anæsthetics, the necessity for getting the vapour quickly out of the chest justifies a more rapid performance of the movements during the first five minutes. After this time the movements should be carried on more slowly, but they should be continued for half an hour at least, and even longer if the warmth of the surface and diminution of lividity gives any reason to hope that the heart has not entirely ceased to act.

2. *Marshall Hall's ready method* is performed by placing the body on one side, and alternately rolling it on its face to compress the chest, and on its back to allow the elasticity of the ribs free movement to draw air into the lungs. The plan is not nearly so effective as Sylvester's, but if no assistant is at hand it is the best mode of artificial breathing that can be adopted.

3. *Howard's method.* *See* Resuscitation.

4. *Mouth-to-mouth insufflation* is not to be depended upon, on account of the difficulty both of keeping the larynx open, and also of preventing the air going down the gullet.

Of the *instruments* introduced for the purpose of carrying on artificial respiration, mention should be made of those invented by Dr. Marcet and Dr. Richardson; but except in the hands of the inventors or of those who had gained much experience in their use by practising upon animals, the writer thinks they would do as much harm as good. The objection to them all is that they interfere with the prompt imitation of the movements of respiration just described.

The administration of *oxygen* is indicated in most cases of artificial respiration, but the results of its use have not been satisfactory hitherto. Now that the gas can be had in a compressed state, and can be given by means of the laughing-gas inhaler, it is worthy of a further trial; but it is certain that in all cases of impending asphyxia time is of so much importance that anything which would delay the supply of oxygen would not be compensated for by giving it pure, instead of in the form of common air. Tracheotomy is not to be thought of in the first instance in any case in which air can be made to pass, even in very small quantity, through the trachea.

For supplemental and after-treatment, *see* Resuscitation. J. T. Clover.

ASCARIDES (*ἀσκαρὶς*, a kind of worm).—This term, by long usage, is often employed to designate the very common intestinal parasites popularly known as *Thread-worms* or *Seat-worms*. Strictly speaking, these do not belong to the genus *Ascaris*, but to the genus *Oxyuris*. The fuller consideration, therefore, of their characters and clinical importance will be found under the Article Thread-worms.

Although the term as employed in the sense referred to is altogether erroneous, there are two true species of the genus Ascaris found infesting man. These are, respectively, the common round-worm or Lumbricus (*Ascaris lumbricoides*); and the moustached or margined round-worm (*Ascaris mystax*). Full particulars respecting the former will be found under Round-worms, whilst the consideration of the latter need only occupy a few words in this place.

Since the discovery and description of the *Ascaris mystax* as a genuine human parasite by the writer in 1868, six instances of its occurrence have been noticed at home and abroad, and there can be little doubt that the parasite is much more frequent in man, especially in children, than is commonly supposed. The writer has also shown that this parasite is identical with the *Ascaris mystax* in the cat, which, according to most helminthologists, is only a variety of the *Ascaris marginata* in the dog. The males are usually from 2 to 2½ inches in length; the females sometimes acquiring a length of 4 inches or more.

Treatment.—Like its congener, the falsely so-called Lumbricus, the margined round-worm readily yields to treatment by santonine. Two or three grains of this drug, followed by castor oil or a saline purgative, should be administered twice or thrice daily for a few days in succession.

T. S. Cobbold.

ASCITES (*ἀσκὸς*, a leathern sac; a large belly).—Synon.: *Dropsy of the peritoneum; Hydrops peritonei vel abdominis; Hydroperitoneum.* Fr. *Ascite*; Ger. *Die Bauchwassersucht.*

Definition.—An accumulation of fluid within the cavity of the peritoneum, more or less serous in character, the accumulation being of the nature of a local dropsy, and not originating in inflammation. The amount of fluid varies much in different cases.

Ætiology and Pathology.—The chief matter

relating to the causation of ascites is to point out the morbid conditions by which it may be produced, as it almost always follows, and is a consequence of certain pre-existing organic diseases, of which it becomes a most important symptom and pathological phenomenon. The causes to which it has been attributed may be discussed according to the following arrangement:—

I. Direct mechanical obstruction affecting the portal circulation.

1. Obstruction of the trunk of the portal vein before it enters the liver, either from external pressure or internal obstruction.

2. Pressure upon or obliteration of the branches of the vein within the liver.

3. Pressure upon the trunk of the hepatic vein, or upon the inferior vena cava after it receives this vein.

II. Cardiac or pulmonary diseases obstructing the general venous circulation.

III. Disease of the kidneys.

IV. Morbid conditions of the peritoneum.

V. Miscellaneous.

I. Any direct obstruction interfering with the portal circulation must necessarily lead to congestion and over-distension of its tributaries, one of the consequences of which is excessive transudation of the fluid portion of the blood into the peritoneal cavity, while absorption is checked. The ascites is, under such circumstances, in short, merely a localised dropsy, resulting from mechanical congestion. The impediment may affect either the portal trunk before it enters the liver; its branches in the substance of this organ; or the hepatic vein or inferior vena cava near its termination.

1. The portal trunk may be pressed upon as it lies in the fissure, by prominences from the liver itself, enlarged absorbent glands in its vicinity, a neighbouring tumour (as cancer of the pancreas or a growth in the small omentum), a hepatic aneurism, or inflammatory thickening resulting from peri-hepatitis. The pressure may absolutely close up the vessel, but it more commonly causes a local clot to form, and thus its channel is blocked up. A thrombus is also in exceptional instances produced in connexion with a diseased condition of the portal vein, such as inflammation or calcification; obstruction to the circulation within the liver; or feebleness of the circulation, with an abnormal tendency to coagulation of the blood.

2. Pressure upon, or obliteration of the branches of the portal vein within the liver, can only arise as a consequence of some morbid condition involving the actual substance of this organ. The hepatic disease which by far most commonly leads to this result, and which is one of the most frequent causes of ascites, is cirrhosis. Occasionally it accompanies syphilitic and other forms of contracted and indurated liver, or it may be associated with infiltrated cancer. The extent of the obstruction thus set up will necessarily vary with that of the morbid changes in the organ. Occasionally a mass within the liver obstructs a considerable branch of the portal vein.

3. Obstruction of the hepatic vein or inferior vena cava is a rare event, but may arise from the pressure of a growth connected with the liver itself, or of some neighbouring tumour.

II. Diseases of the lungs or heart which impede the general venous circulation must necessarily exercise a speedy and direct influence upon the hepatic circulation, and may thus lead to ascites. Usually, however, in cases of this kind the legs are the seat of considerable anasarca before peritoneal dropsy is observed. In course of time the continued congestion originates serious organic changes in the liver, its vessels being more or less obliterated, and consequently it is at this period that ascites is particularly liable to set in.

III. Ascites may constitute a part of the dropsy which so often accompanies renal diseases. It is, however, of comparatively infrequent occurrence to any great extent under these circumstances, the amount of fluid being not considerable as a rule, and the ascites being but a subsidiary part of a general dropsy.

IV. More or less serous effusion into the peritoneal cavity is a pathological result of peritonitis; but, in accordance with the definition of ascites given above, this does not come strictly within the present article. In exceptional instances, however, true ascites is observed as a sequel of peritonitis, in consequence of the morbid conditions which it leaves behind. Chronic peritonitis may also occasion a simple local dropsy; but this is particularly liable to be set up in connexion with morbid formations in the peritoneum, such as cancer or tubercle, of which the writer has seen striking examples. The immediate causes of ascites associated with diseases of the peritoneum may be:—active congestion; implication of the capillaries or minute veins, or even of the larger veins, leading to mechanical congestion; obstruction of the lymphatic orifices, and consequent impaired absorption; or undue activity of the secreting structures.

V. Among the chief *miscellaneous* causes to which ascites has been attributed may be mentioned exposure to cold or wet; the sudden suppression of habitual discharges, or the rapid cure of chronic cutaneous affections; and extreme anæmia and debility. These causes are supposed to originate this symptom either by inducing active internal congestion; or by disturbing the renal functions; or in consequence of the abnormal state of the blood and tissues; but it is very doubtful whether either of them can actually of itself occasion ascites. Fluid may collect within the peritoneum as the result of the rupture of a cyst within the abdomen, especially an ovarian cyst.

It must be remembered that ascites may be due to a combination of two or more of the causes which have been indicated in the preceding remarks. For instance, there may be obstruction affecting the portal circulation within the liver and outside this organ at the same time; or the different organs may be involved simultaneously.

Predisposing causes.—Whatever tends to set up either of the morbid conditions which originate ascites, may be regarded as a predisposing cause. It may be met with at any age, but is most common during middle life. The hepatic form is much more frequent in

males than females. An anæmic condition of the blood and weakness of the tissues predispose to peritoneal dropsy, as they do to dropsy in other parts.

Anatomical Characters.—The essential anatomical character of ascites is the accumulation of a serous fluid within the peritoneal sac. Its amount may range from a few ounces to some gallons. As regards physical characters, the fluid is generally thin, limpid, and watery in consistence; colourless or slightly yellow; clear and transparent; and of alkaline reaction. In exceptional instances, however, it may be coloured by blood or bile; or more or less turbid and dirty-looking; or of thicker and somewhat gelatinous consistence. Soft fibrinous masses occasionally float in the fluid, or these may form spontaneously when it is allowed to stand. Very rarely the reaction is neutral or acid. The specific gravity varies considerably. Chemically the fluid consists of water holding in solution albumin and the usual salts which are found in dropsical fluids; but their proportion is very variable, though the albumin is generally in good quantity, which is evidenced by the degree of coagulation which takes place when the fluid is boiled. Occasionally it contains fibrin, cholesterine, bile-elements, or, in cases of renal dropsy, urea.

The effects of the accumulation upon surrounding structures are to distend and macerate them more or less, or to compress them. Of course along with the ascites there will be the signs of any morbid condition upon which it depends; and there may also be indications of anatomical changes resulting from long-continued pressure of the fluid upon certain structures.

Symptoms and Signs.—Ascites usually sets in very gradually, being chronic in its progress, but advancing steadily. Occasionally, however, the fluid collects with considerable rapidity. The clinical phenomena associated with this pathological condition differ in different cases, both in their exact nature and their degree, according to its cause, the amount of the fluid, and other circumstances, but they may conveniently be considered under the following heads, namely:—1. *Physical signs.* 2. *Mechanical effects of the dropsical accumulation.* 3. *General symptoms.*

1. *Physical Signs.*—Physical examination constitutes a most important part of the clinical investigation of cases of ascites, and it will be requisite to discuss the signs in some detail.

(*a*) If fluid collects in the peritoneum in any quantity, the abdomen presents more or less *general enlargement.* This is often the first change which attracts the patient's attention, and it may also have been noticed that the increase in size commenced below. The degree of enlargement depends upon the amount of fluid, but it may become extreme, so that the skin is tightly stretched and thin, presenting a smooth and shining appearance, or sometimes white lines are visible, due to laceration of its deeper layers. The umbilicus becomes affected in a characteristic manner, being more or less stretched and everted, and finally becoming obliterated, or in some cases more or less pouched out, and it may form a considerable prominence. Should there happen to be a weak portion of the abdominal walls, such as a hernial sac, this will be unduly protruded. The important characters of abdominal enlargement due to uncomplicated ascites are that it is of a rounded form, though tending to be more prominent or to bulge towards the lower part or in the flanks, according to the posture of the patient; that it is quite symmetrical in shape, when the patient stands or lies on his back, but that the form alters considerably with a change of position, the abdomen becoming then more prominent in the dependent region, in consequence of the gravitation of the fluid in this direction, and it may actually be seen to move as the posture is changed. In contrast with the enlarged abdomen, the chest often looks small and depressed, and the fluid may cause its margin to become everted, or it may push forwards the xiphoid cartilage.

(*b*) The abdomen feels perfectly *smooth* and *even* over its entire surface. It usually gives a sensation of *tension* of the walls, without any hardness underneath. In some instances an obscure feeling of fluctuation is experienced on palpation with the fingers.

(*c*) The tendency of ascites is to interfere with the *abdominal respiratory movements,* if it is at all considerable, by preventing the diaphragm from acting properly. At the same time the writer has not uncommonly observed that, even in cases where the accumulation of fluid has been very considerable, abdominal respiration did not seem to be much diminished.

(*d*) *Percussion* affords some of the most important signs of peritoneal dropsy; and when the fluid is present only in small quantity, this is the only mode of examination that can lead to its detection. In the first place marked *dulness* is elicited over the seat of the fluid; while a tympanitic sound, which is often abnormally clear and distinct, is heard over the intestines. When there is but little fluid, it may be impossible to detect any abnormal dulness as the patient lies in the recumbent posture, but on placing him on his hands and knees, the fluid gravitates towards the front of the abdomen, and dulness may then be noticed in the umbilical region. In most cases, however, there is no difficulty in making out the dulness, and this sign is observed in those regions towards which the fluid naturally gravitates. Hence, when the patient lies on his back, the lower part and sides of the abdomen are dull, while its upper and front part is tympanitic. As more and more fluid collects, so the dulness increases in extent, gathering in, as it were, from below and from the sides, until finally the entire abdomen may be dull, except the umbilical region, which remains longest tympanitic. The boundary line between the dulness and tympanitic sound is usually well-defined. As the posture is changed, so will the site of the dulness vary, the part which is undermost presenting this sign, while that which becomes highest is tympanitic; and thus the relative situation of these two sounds, as well as the shape of the dulness, can be altered in a variety of ways. When the patient sits up, the prominence between the recti muscles gives a tympanitic sound on percussion. In exceptional instances a distended colon gives rise to a tympanitic sound along each side of the abdomen, even when there is abundant fluid present.

Another important sign brought out by a kind of percussion is the sensation specially termed *fluctuation*, which is the peculiar wave-like movement realised on placing the fingers of one hand over one side of the abdomen, and fillipping or tapping the opposite side with the fingers of the other hand. This sensation is very easily brought out if there is much fluid present, provided it is free to move, and sometimes the motion is actually visible. Change of posture will modify the seat over which fluctuation can be produced.

(*e*) *Auscultation* yields negative results in cases of ascites, there being no sound of any kind heard over the abdomen.

(*f*) In the large majority of cases ascites is clearly revealed by the physical signs already described. In exceptional instances, however, when the diagnosis is obscure, it is requisite to resort to a *digital* examination through the *rectum*, and in females through the *vagina*. The fluid collects in the recto-vesical pouch, and on examination per rectum, the finger detects the sensation of this fluid through its anterior wall. The vagina is usually felt to be shortened, while the uterus is pushed down and flexed. In extreme cases of ascites the posterior wall of the vagina, or even the uterus itself, may protrude through the vulva.

(*g*) Now and then it is requisite to make use of the *aspirator* or a *small trochar*, by the aid of which not only can it be determined whether fluid is present in the abdominal cavity, but its nature can also be ascertained. This method of examination is further useful when ascites is associated with some other morbid condition within the abdomen, which frequently cannot be made out so long as the fluid remains in the peritoneum.

It must be borne in mind that the ordinary physical signs of ascites will be materially modified or obscured under certain circumstances. For example, the quantity of fluid may be so small that most careful examination is required in order to detect its presence; on the other hand, it may be so abundant that dulness is observed over the entire abdomen, and fluctuation may be very indistinct. The existence of peritoneal adhesions—for instance, those which may be formed as the result of repeated paracentesis—also renders some of the most characteristic signs of ascites very ill-defined. Again, the association of peritoneal dropsy with some other abdominal morbid condition, such as a new growth, an enlarged liver or spleen, or an ovarian tumour, will also modify the signs elicited. The mesentery may be abnormally short, or the intestines may be adherent, thus being prevented from floating forwards, so that the usual relative positions of dulness and tympanitic sound are not observed.

2. *Mechanical effects of the dropsical accumulation.*—The clinical phenomena resulting from the mechanical effects of ascites are both *subjective* and *objective*. The patient often experiences a feeling of uneasiness and discomfort in the abdomen, as well as more or less tension and fulness, if there is much fluid present; while there may be a sense of fatigue and aching about the loins or abdominal walls. As a rule no particular pain is felt, but colicky pains are liable to occur from time to time, and extreme distension of the structures constituting the abdominal wall may also cause painful sensations. In exceptional instances peritonitis is set up. When the fluid is abundant, the patient experiences its weight when he walks, and, during this act, he throws the head and shoulders back, at the same time keeping the legs apart. Symptoms connected with the alimentary canal are of common occurrence, but these are often to a great extent due to the same cause which originates the ascites, though the fluid must necessarily tend to interfere with the functions of the stomach and intestines. The bowels are usually constipated, but in some instances diarrhœa or dysenteric symptoms may arise. Flatulence is very commonly complained of, even a small amount of gaseous accumulation in the intestines being felt unduly, producing much discomfort, and increasing the enlargement of the abdomen temporarily. Occasionally vomiting occurs, in consequence of interference with the stomach. When considerable fluid has remained in the peritoneum for some time, it presses upon the inferior vena cava and prevents the return of blood through this vessel, and may thus lead to anasarca of both lower extremities, with enlargement of the superficial abdominal veins. Exceptionally the anasarca attracts attention at an early period. The flow of blood through the renal veins may also be obstructed, inducing mechanical congestion of the kidneys, with consequent diminution in the quantity of urine and albuminuria. In rare instances the fluid has been known to accumulate to such an extent as to rupture some part of the abdominal walls.

Ascites also frequently interferes with the thoracic organs. The bases of the lungs are more or less collapsed, and the breathing becomes chiefly upper-costal, while a sense of dyspnœa is experienced, especially in the recumbent posture and after taking food, the breath is short on exertion, and the respirations are often hurried and shallow. The heart is likewise liable to be disturbed in its action, as evidenced by palpitation, irregularity, or a tendency to faintness. This organ may also be displaced, so that its apex-beat is raised and too far towards the left, and in rare instances a basic systolic murmur has been originated as a result of this displacement.

3. *General symptoms.*—The general system is frequently seriously affected in cases in which ascites is a prominent symptom, but this usually depends upon the cause or causes which have originated the dropsy, though it may itself induce more or less debility, wasting, anæmia, and other general effects. The loss of fluid in this way has also been supposed to lead to deficient perspiration, and consequent dryness of the skin; as well as to diminution in the quantity of urine.

Diagnosis.—The first matter bearing upon the diagnosis of ascites is to determine whether this morbid condition actually exists. The presence of fluid in the peritoneum, as well as its amount, can only be positively made out by physical examination, and in the great majority of cases the signs thus elicited are quite charac-

teristic. When the fluid is small in quantity, as well as under other circumstances in which the physical signs are obscured or modified, the diagnosis may be difficult and uncertain, but it may then be aided by a knowledge of the existence of some disease likely to give rise to ascites. That the accumulation of fluid is of a dropsical nature, and not due to acute or chronic peritonitis, is usually sufficiently obvious from the history of the case, and the collateral symptoms, while the local signs are also of a different character (*see* PERITONEUM, Inflammation of). The remaining abdominal enlargements from which ascites has to be most commonly distinguished are those due to flabby relaxation of the walls of the abdomen, combined with flatulence; accumulation of fat in the subcutaneous tissue and omentum; abundant subcutaneous œdema, which may be associated with and obscure ascites; an ovarian tumour; or a pregnant uterus. Among the rarer conditions with which ascites is liable to be confounded may be mentioned colloid disease of the omentum; a greatly dilated stomach; distension of the uterus with fluid; great accumulation of urine in the bladder; a very large hydatid tumour, usually connected with the liver; extreme cystic enlargement of the kidney; and the so-called 'phantom tumour.' Most of these conditions are described in other parts of this work, and the limits of this article forbid any discussion of their several diagnostic characters; but a consideration of the history and existing symptoms of the case, combined with the results of a proper physical examination, constitute the data upon which the diagnosis is founded. It must be remembered that ascites may coexist with other morbid conditions in the abdomen, their physical signs being combined. Should there be an enlarged organ or other solid mass, it may often be recognised by making sudden firm pressure with the fingers over the abdomen, when the fluid is pushed aside, and the underlying resistance can be felt; or paracentesis may be performed, and further examination carried out after the evacuation of the fluid.

Another most important point in the diagnosis of ascites is to make out its *cause*. For this purpose all the facts bearing upon the case must be taken into account and carefully weighed, special attention being paid to the liver and the structures in its vicinity, to the heart, and to the kidneys. The amount of the ascites, and its relation to other forms of dropsy, afford considerable aid in the diagnosis. If it results from cardiac or renal disease, ascites always follows dropsy in other parts of the body, to which it is also generally subordinate; when it is due to hepatic or some neighbouring disease, the peritoneal dropsy appears first, and is throughout most prominent. Should the vena cava inferior be obstructed at its upper part, anasarca of the legs will be observed simultaneously with, or even before the ascites.

PROGNOSIS.—The prognosis of ascites will mainly depend upon its cause; the amount of fluid present; the state of the patient; the condition of the main organs; and the results of treatment. In some cases this symptom is in itself attended with immediate danger, on account of the mechanical effects of the dropsical accumulation, especially upon the thoracic organs, and still more if these organs are in a diseased condition. In other instances it aids in reducing the patient, and in thus bringing about a fatal termination. When ascites is due to local interference with the portal circulation, great relief can unquestionably be afforded in a considerable number of cases, and life may be prolonged by appropriate treatment; while, if the local cause is not such as in itself to lead to a fatal issue, the ascites may not infrequently be permanently cured.

TREATMENT.—The principles of treatment applicable to cases of ascites are (*a*), to attend to the condition upon which the dropsy depends, and thus endeavour to get rid of its cause; (*b*) to promote the absorption of the fluid; (*c*) to improve the constitutional condition and the state of the blood, if necessary; (*d*) to remove the fluid by operation, if absorption cannot be accomplished; and (*e*) to treat any symptoms needing special attention.

(*a*) As an important part of the treatment directed to the *cause* of ascites, particular attention must be paid to those organs which are most commonly accountable for this symptom, though unfortunately in a large proportion of cases but little effect can be produced upon the dropsy in this way.

(*b*) Absorption of the fluid is chiefly promoted by acting freely upon the bowels, skin, or kidneys. The class of remedies indicated will vary in different cases, and must be adapted to the state of the different organs, but as a rule active purgatives are most efficient in relieving ascites, especially when due to local causes, of which the most useful are compound jalap powder, cream of tartar, elaterium, calomel, gamboge, podophyllin, and croton oil. These remedies must, however be used with due caution. In some instances balsam or resin of copaiba has proved useful in the treatment of peritoneal dropsy. Assistance may be derived in certain forms of ascites from acting upon the skin by means of various diaphoretic baths. Digitalis and squills may be of service as diuretics; or the application of poultices of digitalis leaves over the abdomen is occasionally attended with benefit. The administration of iodide of potassium also seems to aid absorption in some cases.

(*c*) Treatment directed to the general condition of the patient, and to the state of the blood, is undoubtedly valuable in many cases of ascites. Tonics are often of decided service, and preparations of iron are specially indicated for improving the quality of the blood, if there is any tendency to anæmia. Not only do these remedies sustain the patient, but they may also have an influence in promoting the process of absorption. The diet must be adapted to the circumstances of the case, but usually needs to be of a nutritious character.

(*d*) In a considerable proportion of cases, nowever, no effect is produced upon the dropsical accumulation by any of the measures thus far considered. Then it becomes necessary to determine whether it is desirable to remove the fluid by operation. The fluid may be taken away either by means of the aspirator, or by the trochar and canula. The advisability of

having recourse to this plan of treatment must depend upon circumstances. The ascites is frequently not sufficiently abundant to justify paracentesis, and when the condition is of cardiac or renal origin, the operation can only afford temporary relief, so that there is no object in resorting to it unless the mechanical effects of the accumulation are such as to cause troublesome or dangerous symptoms, and it had better be delayed as long as possible. When ascites is a local dropsy, the fluid is often so considerable in amount as to necessitate its removal for the mere purpose of giving relief for the time. In cases of ascites associated with malignant disease, for instance, this is all that can be hoped for, as the fluid will certainly collect again. When, however, the condition is due to some local disease which is not in itself fatal, and especially to cirrhosis of the liver, the writer has found signal benefit result from the *repeated performance of paracentesis*, and has advocated this plan of treatment as a *curative* measure, so far as the ascites is concerned. Rarely does the operation give rise to any immediate ill-effects, and it is frequently found that remedies will act much more efficiently after the removal of the fluid than they did previously. In the writer's experience paracentesis repeated as often as the fluid re-accumulated has ultimately led to a complete cure in several instances; in others the cure was partial, a certain quantity of fluid remaining in the peritoneum, limited by adhesions; while in others still, life has been greatly prolonged, and much comfort afforded. The repeated accumulation does not seem to affect the system materially by reason of the drain upon it, and frequently not at all. Of course due care must be exercised in the performance of the operation, and in the subsequent treatment. In a few days after the removal of the fluid, the application of a bandage firmly round the abdomen, so as to exert even pressure, may prove of service in aiding the absorption of what remains, and preventing the recurrence of the ascites; and this measure may also be useful when a certain amount of fluid continues after the repeated performance of paracentesis.

(*e*) The symptoms resulting from ascites which are likely to require attention are those connected with the alimentary canal; dyspnœa; and cardiac disturbance, or a syncopal tendency. These should be treated on ordinary principles; but it must be observed that marked dyspnœa, if evidently due to the fluid, is an indication for the immediate performance of paracentesis.

FREDERICK T. ROBERTS.

ASIATIC CHOLERA. *See* CHOLERA.

ASPHYXIA (ἀ, priv., and σφύξις, pulse).—SYNON.: Apnœa; Fr. *Asphyxie*; Ger. *Erstickung*.

DEFINITION.—The term *Asphyxia*, though literally signifying *pulselessness*, is generally understood to mean the condition that supervenes on interruption of the function of respiration. The term *Apnœa*, preferred by many as a more exact one, has the disadvantage of being employed by physiologists in a totally different sense, viz. the cessation of the respiratory movements consequent on artificial hyperoxygenation of the blood. There is therefore no advantage to be gained by substituting the term apnœa for the well-understood and older one, asphyxia.

ÆTIOLOGY.—Asphyxia may result from many causes which obstruct or interrupt the respiration. They may be divided into two categories, internal and external.

Internal.—These include paralysis of the respiratory nerve-centres by disease or injury of the medulla oblongata; paralysis of the nerves or muscles of respiration; a rigid fixation of the respiratory muscles; collapse or disease of the lungs; occlusion of the air-passages by organic disease or spasm of the glottis, pressure of tumours, and the like.

External.—To this group belong occlusion of the air-passages by foreign bodies; pressure on the chest not capable of being overcome by the muscles of respiration; closure of, or external pressure on, the air-passages, as in suffocation, strangulation, or hanging. These are all cases of obstruction of the respiratory movements in a medium capable of supporting life. To these external causes are to be added those conditions in which, though the respiratory movements are free, the surrounding medium is incapable of oxygenating the blood, viz., submersion in a liquid medium (drowning); or being surrounded by a medium devoid of oxygen, such as nitrogen or hydrogen. These gases have a purely negative effect; but many other gases which are classed as asphyxiants, such as carbonic oxide, sulphuretted hydrogen, chlorine, chloroform vapour, etc., have positive poisonous effects, and should therefore be called by some special name, such as *toxic asphyxiants*, to distinguish them from those which have no such properties.

PHENOMENA.—When an animal is placed in an atmosphere devoid of oxygen, or not containing a sufficient quantity of this gas (under 10 per cent.) to maintain the respiratory process, or if the mechanism of respiration is simply obstructed, it begins to show signs of agitation and to make powerful inspiratory and expiratory efforts, in which the accessory muscles of respiration are all brought into action; the arterial tension increases; and the superficial veins become distended and livid.

After a variable period these dyspnœic efforts pass into general convulsions, in which the muscles of expiration are more especially in action, during which the sphincters are forced and the excretions voided. On these there follows a calm, during which the animal lies insensible, with dilated and immovable pupils, and with reflex excitability abolished generally. All muscular movements cease except those of inspiration, which are repeated at intervals. As death approaches the respiratory movements become shallower and less regular, and are succeeded by stretching convulsions, during which the back is straightened, the head is thrown back, the mouth gapes, and the nostrils dilate. The heart still continues to beat after other movements have ceased. The heart ultimately stops in the state of diastole. Death is then complete and final.

COURSE AND TERMINATION.—The time necessary to bring about a fatal termination varies in different animals, and in the same animal under

different conditions. It has been noted that the young of some animals resist asphyxia longer than the adults. Paul Bert has shown that these differences are all explicable in accordance with the law that the more active the vital combustion, the greater the gaseous interchange, and therefore the more rapidly fatal the obstruction of the respiratory process. Excluding special considerations of this kind it may be stated as the result of the experiments of the Medical and Chirurgical Committee on Suspended Animation (*Med.-Chir. Trans.* vol. xlv. 1862) that when the respiration of a warm-blooded animal is totally obstructed, all external movements cease in from three to five minutes, and the heart stops within ten minutes. Certain modifications occur according to the method in which asphyxia is produced (*see* DROWNING).

ANATOMICAL CHARACTERS.—The blood is of a dark colour, owing to complete reduction of the hæmoglobin, and the proportion of carbonic acid is greatly increased. Owing to the excess of carbonic acid, the blood coagulates slowly or imperfectly; hence it remains long fluid, or forms few and soft coagula. The venous side of the heart, the great venous trunks, and the pulmonary artery are distended with dark blood; while the left side varies, being sometimes full, more often perhaps either empty or containing a small quantity of dark blood.

The appearance of the lungs is not constant. These organs are by no means always congested, as is very generally stated, being more often pale and anæmic. The posterior and dependent parts become hypostatically congested *post mortem*. The abdominal viscera are usually congested. The appearance of the brain varies, this organ being either anæmic or more or less congested. Special signs characterise special modes of causation of asphyxia.

PATHOLOGY.—Inasmuch as the cessation of respiration means both oxygen-starvation and accumulation of carbonic acid, the question is whether the phenomena of asphyxia depend on the one or the other, or on both. Various opinions have been entertained on this subject, but the experiments of Rosenthal and Pflüger would seem to show that the deprivation of oxygen is the chief factor. That the accumulation of carbonic acid has no effect at all cannot, however, be maintained, for it is demonstrable that carbonic acid has a distinct toxic effect on living tissues.

The circulation of non-oxygenated blood through the lungs and the respiratory centre in the medulla oblongata is the cause of the powerful respiratory efforts in the first stage—directly, by stimulation of the respiratory nerve-centres; indirectly, by peripheral irritation of the pulmonary branches of the vagi. The respiratory movements increase in force, and the irritation irradiates into the centres of other movements besides those directly concerned in respiration, giving rise to the expiratory convulsions which have been ascribed by some to excitation of a special 'convulsion-centre' (*Krampfcentrum*).

The respiratory centres ultimately become paralysed, but subsequently to those of conscious activity—the brain; and of reflex action—the spinal cord.

The circulation of non-oxygenated blood likewise causes contraction of the arterioles from irritation of the vaso-motor centre. Increased resistance is thus offered to the heart, and this is intensified by the convulsive muscular efforts. The arterial tension rises. The resistance to the flow through the capillaries by contraction of the minute blood-vessels occurs not only in the systemic, but also in the pulmonary circulation. Hence there is resistance both to the arterial and venous side of the heart. The ventricles become distended, and the heart's action laboured. The heart becomes enfeebled by the circulation of non-oxygenated blood in its walls, the diastolic intervals become longer, until the heart finally stops in a state of diastole, with the right side full, while the left may have succeeded in emptying itself.

TREATMENT.—Resuscitation from pure asphyxia is possible so long as the heart continues to beat. After cessation of the heart's action treatment is unavailing, except in cases of cessation from mere over-distension, in which bleeding from the external jugular vein may be resorted to with success. The chief indication in the treatment of asphyxia is to effect oxygenation of the blood by the introduction of air into the lungs. If the medium by which the patient is surrounded is incapable of supporting respiration, he must be immediately removed, or the atmosphere changed. If the air-passage is obstructed by a foreign body, this must be extracted; if this is impossible, or if the obstruction result from disease, tracheotomy or laryngotomy must be resorted to. Means must be adopted of exciting the respiratory centres or respiratory muscles to action; or if these are paralysed and non-excitable, the natural movements of respiration must be imitated artificially, or air introduced by insufflation.

The respiratory centres, if not absolutely paralysed, may be excited reflexly by stimulation of cutaneous nerves, especially those of the face and thorax. This may be effected bythe stimulus of sudden cold, or better by alternate dashing of hot and cold water on the face and chest, or by flicking the skin with a towel. These reflex stimuli are often of themselves sufficient to excite respiratory movements; if not, they are powerful subsidiary aids to artificial respiration. The diaphragm may be stimulated to contraction by galvanisation of the phrenic nerve, one pole being placed on the nerve as it crosses the scalenus anticus at the root of the neck, the other on the epigastrium. Chief reliance, however, is to be placed on the methods of *artificial respiration*, which, after all, are the most simple and the most effectual, and possessed of the pre-eminent advantage of being always available. *See* ARTIFICIAL RESPIRATION.

Air may also be introduced into the lungs directly by properly constructed *insufflation-apparatus*, either by the insertion of a tube within the larynx (an operation requiring dexterity, but without danger if skilfully performed, though there is always risk of rupture of the air-vesicles from over-distension); or more easily by the insertion of the tube in one nostril, the other nostril and the mouth being closed (Richardson's apparatus). *Mouth-to-mouth-insufflation* is sometimes of advantage, especially in infants. The operator must close the nostrils of the patient,

and, applying his mouth directly to that of the patient, inflate the lungs by his own expiratory efforts. The tendency to inflation of the stomach is considerably counteracted by backward pressure on the larynx. D. Ferrier.

ASPIRATOR.—Synon.: Fr. *Aspirateur.*—The operation of Pneumatic Aspiration was introduced into practice by Dieulafoy in 1869. Before this period various instruments had been used under the name of 'suction-trochars,' but to Dieulafoy is due the credit of fully appreciating their value.

Description and Mode of Employment.—The aspirator consists of a glass syringe, having at its lower end two openings provided with stop-cocks. When the piston is raised and the cocks are closed a vacuum is created in the syringe, which can be maintained by fixing the piston in the withdrawn position. An india-rubber tube is fitted into each of the two openings, and these must be provided with coils of wire inside to prevent them from collapsing. At the end of one tube is fixed a fine hollow needle. The needle should have only one opening, at the point, and not, as is often seen, another at some distance from it. The instrument is thus used:—A vacuum having been created in the syringe by raising the piston whilst both stop-cocks are closed, the needle is introduced into the part to be operated upon. As soon as the opening of the needle is beneath the skin the stop-cock leading to it must be opened. The vacuum will then extend to the point of the needle; and consequently, if it be gently pushed onwards the moment it encounters fluid, this will jet up into the glass syringe, when its nature may be ascertained. This mode of operating with what Dieulafoy calls the 'previous vacuum' is the essential difference between aspiration and suction. In aspiration it is impossible to pass the needle through a collection of fluid without discovering it; whereas without the 'previous vacuum' in the needle this might readily be done. If the fluid is sufficient in amount to fill the syringe, the stop-cock leading to the needle is to be closed and the other opened, by which the fluid may be discharged. The vacuum may then be re-established, and the operation repeated as often as is necessary. By opening both stop-cocks at once and allowing the discharge tube to hang down, the aspirator may be converted into a syphon. The action of the instrument may also be reversed, and it may be employed for injecting fluids. Other varieties of aspirator are in use besides the one above described. In Weiss's the receiver is a glass bottle, from which the air is exhausted by means of a separate exhausting syringe. The objection to this is that if the needle becomes choked, it cannot be cleared by pushing down the piston and driving some of the fluid back through it. Other kinds of aspirator cannot be converted into syphons, and these are objectionable. Weiss's has the advantage of being less liable to get out of order, as the fluid does not touch the exhausting syringe. The needles employed vary in size. Dieulafoy recommends that they should be about $\frac{1}{50}$, $\frac{1}{25}$, $\frac{1}{20}$, and $\frac{1}{12}$ of an inch in diameter, and calls them Nos. 1, 2, 3, and 4 respectively. The aspirator may also be applied to trochars, but then its distinctive feature is gone, and it becomes but a 'suction trochar.'

The following rules must always be observed in using the aspirator. 1st. See that the needle is pervious and clean and the syringe in order before using it. It is advisable to wash the needle well in strong carbolic acid solution. 2nd. The needle must be pushed straight on in one direction only. Its course must never be altered while the point is under the skin. If no fluid is found, it may be withdrawn and reinserted. It must be held as steady as possible during the aspiration. 3rd. If the fluid will not flow with the force of the vacuum, it is of no use squeezing and pressing the part. This can only do harm. 4th. Aspiration must cease at once when blood comes in any quantity, especially in abscesses. 5th. Keep up the vacuum during the withdrawal of the needle, lest some of the morbid fluid be left in its track. 6th. If the needle becomes choked, force a little of the fluid back through it in order to clear it.

Uses.—Aspiration is used for purposes of diagnosis and treatment. Dieulafoy asserts that with the No. 1 needle it is possible to search for fluid without danger, whatever may be its seat or its nature; and experience has proved this to be practically true. In treatment it has been employed in the following affections:—

Abscesses.—In acute abscesses aspiration is usually of little value, as the pus soon re-accumulates. In chronic abscess connected with diseased bone it usually fails; and often it is impossible, from the amount of cheesy matter in the pus. In chronic abscesses unconnected with bone it sometimes effects a complete cure after three or four repetitions. It has proved successful in curing perinephritic abscess in the writer's experience. It is always well in chronic abscesses of doubtful origin to give this mode of treatment a trial. It must be remembered in treating large chronic abscesses that a dirty needle may lead to decomposition of their contents. *Diseases of the Liver.*—Hydatid cysts have been successfully treated by aspiration. In many cases the fluid becomes purulent after one or two aspirations, and in some the cyst has opened externally. For purposes of diagnosis the small needles may always safely be thrust into the liver. Abscess of the liver has been successfully treated by the aspirator. *Retention of Urine* may always be safely relieved by using No. 2 needle above the pubes. *Ovarian cysts* may be diagnosed and treated in the same way. *Hernia.*—It has been asserted that strangulated hernia may be, in the great majority of cases, relieved by the use of the aspirator. The finest needles only should be used. They remove first the fluid from the sac, after which some gas may be obtained from the strangulated gut, but fæcal matter rarely fails to choke the tube. In this country surgeons have not succeeded in sufficiently emptying the gut to allow of its reduction. Experience has, however, shown that if the needle be kept steady, any number of punctures may be safely made into the gut. *Diseases of Joints.*—Aspiration is occasionally useful in acute synovitis. Great care must be taken not to scratch the inside of the joint with the needle, as this has been known to lead to acute arthritis and suppuration. No. 1 or 2 needle

should be used. *Hydrocephalus* and *Spina bifida* may be aspirated with safety with No. 1 needle. In hydrocephalus it is to be passed through the anterior fontanelle. No case has hitherto been cured by this treatment. In *Pleurisy* and *Ascites*, except for purposes of diagnosis, in the writer's opinion the aspirator presents no advantages over a trochar properly constructed so as to exclude air (*see* PARACENTESIS). *Pericarditis.*—The operation of aspiration has frequently been successfully performed for pericardial effusion. It is thus carried out:—A spot is chosen 2 to $2\frac{1}{2}$ in. (5 or 6 centimetres) beyond the left edge of the sternum, in the 4th or 5th interspace. No. 2 needle is then passed obliquely upwards and inwards, taking care to turn on the vacuum as soon as the eye is covered. The moment the fluid jets into the syringe the needle must be held steadily till the flow ceases. If this be done there is no danger of wounding the heart. If there is any doubt as to the existence of fluid, No. 1 needle must be employed, with which the heart may be punctured without great danger.

MARCUS BECK.

ASTHENIA } (ἀ,priv.,and σθένος,strength).
ASTHENIC }
—Terms signifying want of strength. As applied to the entire system, they indicate considerable general debility; in connexion with particular diseases, they imply that these are attended with marked weakness.

ASTHENOPIA (ἀ, priv., σθένος, strength, and ὤψ, the eye).—Weakness of sight. *See* VISION, Disorders of.

ASTHMA, SPASMODIC (ἆσθμα, from ἄω, I blow).–SYNON.: Bronchial Asthma. Fr. *Asthme*; Ger. *Bronchial-Asthma.*

DEFINITION.—An affection characterised by severe paroxysmal dyspnœa, recurring at more or less well-marked periods, generally in the night, the dyspnœa being due to spasmodic contraction of the bronchi, produced by a variety of causes.

ÆTIOLOGY.—The causes that induce an attack of asthma are very various, and may be roughly classed according to their action, *direct* or *indirect*, on the respiratory organs. In the former the exciting cause immediately affects the mucous membrane; in the latter it does so in a more circuitous manner, as through the blood or the nervous system generally:—

- Direct
  - Dust.
  - Vegetable irritants.
  - Chemical vapours.
  - Animal emanations.
  - Climatic influences.
  - Bronchial inflammation.
- Indirect
  - Through the nervous system
    - Centric.
    - Excito-motor.
  - Through the blood
    - Gout.
    - Syphilis.
    - Skin diseases.
    - Renal diseases.
  - Heredity.

Direct causes.—Common roadside dust; fluff from woollen clothing; the dust of mills, threshing-floors, or bakehouses; and any mechanical particles when inspired, will produce in some persons an asthmatic seizure, dust of low specific gravity being more apt to have this effect than heavy particles like coal, steel filings, etc., from which arise lesions in the lung of a more permanent and serious character.

The odour evolved by certain vegetables, such as ipecacuanha; the pollen of many grasses and plants (*see* HAY-FEVER); certain chemical vapours, as that of pitch, sulphurous acid, and phosphorus fumes; the peculiar smell of some animals, as dogs, cats, horses, and hares, may each provoke a spasm in individual cases.

A still more powerful cause is climatic influence, the action of which on different patients cannot, unfortunately, be reduced within the limits of law, but depends mainly on the idiosyncrasy of the individual. Extremes of temperature, or excessive dryness or dampness, may produce an asthmatic seizure, but in the largest number of cases one of two elements appears as the chief factor. One large class of sufferers trace the attack to *dampness*, whether of soil or of atmosphere, in combination with either heat or cold; another to *closeness* of atmosphere and a want of proper circulation of air, such as is found in deep valleys and thick forests, and during thundery weather—this last class experiencing great relief when a breeze springs up. Malaria plays an important part occasionally in the causation of asthma.

Far more general and intelligible in its action is bronchial inflammation, which is the cause in 80 per cent. of asthmatic cases. It frequently happens that after whooping cough, measles, or infantile bronchitis the tendency towards asthma begins to appear. These diseases, implicating as they do both bronchial muscle and nerve supplying it, leave their mark behind, either in irritability of the mucous membrane; in induration of some portion of the lung, generally at the root; or in enlargement of the bronchial glands, causing pressure on the pneumogastrics, or on some of the branches of the pulmonary plexuses (*see* BRONCHIAL GLANDS, Diseases of); and thus we often find that the diseases which implicate the bronchial tubes in childhood lay the foundation of asthma in after-life.

Indirect causes.—This class of causes includes those acting through the general nervous system; those acting through the blood; as well as the more or less structural one of heredity.

The *centric* subdivision embraces attacks arising from emotion, anger, or fright; as well as the curious alternations of asthma, neuralgia, angina, and gastralgia due to some centric irritation in the medulla, involving the origins of the fifth and eighth pairs of nerves, and manifesting itself by affecting first one branch and then another of these nerves.

Excito-motor causes may be illustrated by indigestion or costive bowels giving rise to a paroxysm of asthma. In the first case, irritation of the medulla is induced through the gastric branches of the pneumogastric, and a motor effect is reflected through the pulmonary branches. These *peptic* attacks, as they are called, occur more frequently after suppers than dinners, probably because reflex irritability is always exalted by sleep, as we know to be the case in epilepsy and the teething convulsions of childhood.

Gout, towards old age, often takes the form of asthmatic seizures, which alternate with the

articular affections. In like manner attacks of the disease have been attributed to syphilis.

The connexion between asthma and various kinds of skin-disease is intimate; the subsidence of eczema, of urticaria, or of psoriasis, has often been accompanied by fits of spasmodic breathing, which have ceased on the reappearance of the eruptions. Here, again, the state of the blood is presumed to be the origin of both maladies, as in disease of the kidneys, which will be again referred to.

Heredity can be traced in about 40 per cent. of asthmatics, though the tendency often does not show itself till late in life. The characteristic form of chest is often transmitted from parents to children; and even when this is not so, a disposition towards spasmodic symptoms in catarrhal attacks is often seen in the children of some asthmatics.

Symptoms.—The patient retires to bed with few or no premonitory symptoms, and sleeps for some hours, but is disturbed in the late night or early morning—two A.M. is a common time—by a feeling of oppression approaching to suffocation, referred either to the throat, sternum, or epigastrium, which obliges him to sit up in order to breathe. Sometimes the onset is more gradual; the patient, having fallen asleep in spite of uneasy sensations, begins to wheeze during sleep, and is only aroused when the dyspnœa becomes severe. The breathing is accompanied by a humming sound, which gradually developes into a great variety of discordant noises.

In order to increase the capacity of his chest to the utmost, the asthmatic patient sits up and fixes his shoulders, either by placing his hands on either side of him, or by supporting his elbows by his knees; or sometimes he stands leaning over the back of a chair or other support. In one or other of these positions he remains immovable, with chest, back, shoulders, and head fixed; unable to speak or even to move his head; the lips being parted; the face pale, anxious, and, if the dyspnœa continue, livid; and the eyes prominent and watery. Every muscle of respiration, ordinary and extraordinary, is brought into requisition; those passing from the head to the shoulders, to the clavicles, and to the ribs become rigid, and, in place of moving the head and neck, act the reverse way, being used as fixed points to raise and dilate the thorax. The trapezii and levatores anguli scapulæ by their contraction elevate the shoulders, in order that the muscles connecting these with the ribs may act as elevators to the latter. Even the muscles of the back are pressed into the service, and they almost cease to support the back; consequently the patient stoops. At each inspiration the sterno-cleido-mastoids stand out like cords, leaving a deep hollow between their sternal attachments; the diaphragm is contracted, and hence the stomach, liver, and heart are somewhat displaced. With all this display of muscular force, the chest remains almost motionless, being expanded to a variable extent.

In spite of the great dyspnœa, respirations are not proportionately frequent, seldom exceeding thirty, and sometimes falling to nine a minute. The expiration is prolonged, being generally two or three times as long as the inspiration. The pulse is usually slow and feeble; the temperature rarely exceeds 99° Fahr., and is often below 98° Fahr. Analysis of the expired air shows the oxygen to be almost entirely replaced by carbonic acid, which may increase from the normal to as much as 11 per cent., the nitrogen varying from 89 to 93 per cent. The arrest of expiration is probably the cause of the accumulated carbonic acid, but the total disappearance of the oxygen is hardly to be explained, for that oxidation of the tissues does not proceed, is shown by the pale urine passed after the fit.

Physical Signs.—These reveal less than might be expected. The percussion-note is somewhat raised over the whole chest, most so in the posterior regions, where a drum-like sound occasionally prevails: this hyper-resonance is probably due to accumulation of air induced by obstructed expiration, and in incipient cases passes off with the attack.

Auscultation shows an entire abolition of the normal breath-sounds, and the existence of dry sibilant or sonorous rhonchi, everywhere varying in tone according to the calibre of the bronchial tubes; the smaller ones giving the high notes, and the larger ones the deep notes. These sounds continually change their position, springing up under the listening ear, and as quickly vanishing again to give place to profound silence.

Progress and Duration.—A paroxysm of asthma, when once established, lasts from half an hour to several days, and generally terminates with expectoration—thin and transparent if the seizure be short; but abundant and more or less opaque if the fit be prolonged, or if the case be chronic. The urine is light-coloured and plentiful; and flatus is often expelled from the bowels. Little or no food is taken during the attack, at the close of which the patient falls asleep.

The recurrence of the attacks when once they have been excited is generally periodic, but much depends on the presence or absence of the exciting cause. In many cases the patient is quite free from wheezing and dyspnœa in the intervals, and feels and acts like other people; but when the attacks follow each other closely, a more or less wheezy condition remains behind, and a few signs of obstructed breathing are generally to be detected in the interscapular regions.

Complications and Sequelæ.—If the asthmatic attacks become habitual, their effects are seen on the frame and on the organs implicated. The shoulders become raised, the head being buried between them; the muscles of the back, owing to their being called on to act as extraordinary muscles of respiration, are diverted from their use as erectors of the spine, which, accordingly, yields in the anterior direction, and the patient stoops. The frequent occurrence of spasmodic contraction of the bronchi causes hypertrophy of their muscular coat; and this, with or without the congestion of the mucous membrane accompanying it, leads in time to thickening of the tubes and permanent narrowing of their calibre. The more common result of asthma is emphysema, arising from the difficulty of expiration. The emphysema, at first temporary, becomes in chronic cases permanent, and gives rise to displacement of the adjoining organs (*see* Emphy-

SEMA). Contraction of the bronchia largely influences the pulmonary vessels, and considerable obstruction of the pulmonary circulation is the result. The vessels become gorged, and sometimes the lungs œdematous. If the emphysema be extensive, we may in time expect dilatation of the right side of the heart and marked prominence of the veins of the breast and neck, and the effects may be carried so far as to cause œdema of the lower extremities with albuminous urine, as the writer witnessed in a case where the latter symptoms disappeared on the subsidence of the asthma.

PATHOLOGY.—Patients rarely, if ever, die of spasmodic asthma, though death may ensue from some of its complications and sequelæ; and the disease being a functional one, cannot be said to have any morbid anatomy. The onset and departure of the attack, and the ever-changing physical signs, led Laennec to think that, whatever obstruction in the bronchial tubes caused the phenomena, must be of a spasmodic and transitory nature. He therefore concluded that asthma was due to a spasm of the bronchial muscles which had been described by Reisseissen. Laennec also showed that an asthmatic sufferer could sometimes, after holding his breath, actually breathe naturally for one or two respirations, thus clearly demonstrating that the spasm was capable of momentary relaxation. Other theories were put forward, and doubt was thrown on the existence of muscular fibres in the bronchi, until Dr. C. J. B. Williams proved their existence by his experiments on the lungs of oxen, dogs, rabbits, and other animals, when he caused contraction of the trachea and bronchial tubes by the application of electrical, chemical, and mechanical stimuli. The muscular coat was shown to be more abundant in the smaller tubes than in the larger, the former contracting sufficiently to entirely obliterate their passages. In asthma, excitation of the muscle probably takes place through the anterior and posterior pulmonary plexûs, which are made up of branches from the pneumogastrics, recurrent laryngeals, the spinal nerves, and the ganglia of the sympathetic, thus giving the bronchial tubes a very wide area of connections. The branches of the pulmonary plexûs form a network round the bronchial tubes, and contain some minute ganglia. When the cause is direct, as dust of any kind or climatic influence, the spasm may be induced by reflex action through these small ganglia, or through the pulmonary plexûs, though it soon extends deeper into the nervous system, involving the pneumogastrics, and causing a motor effect on the thoracic muscles through the upper cervical, phrenic, and dorsal nerves. Where emotion, fright, or laughter starts the fit, the irritation is centric, and causes a motor effect on the pulmonary plexûs through the pneumogastrics. Where, again, indigestion excites it, the sensation passes through the gastric branches of the pneumogastric, and is reflected by the motor filaments of the pulmonary plexûs. Lastly, where gout, syphilis, skin-disease, and heredity are the excitants, we may regard the blood itself as causing the local irritation. Spasmodic asthma may, therefore, be considered as a neurosis of the pulmonary branches of the plexûs of that name, similar to other neuroses, as hemicrania and sciatica, and giving rise through the motor nerves of the plexûs to spasm of the bronchial muscle.

DIAGNOSIS.—Asthma is distinguished from *bronchitis* by the fugitive physical signs; by the spasmodic character of the dyspnœa; and by the scant expectoration. The breathing in bronchitis, if at all difficult, is hurried; in asthma it is slow, wheezy, and prolonged; this feature also contrasting strongly with the gasping, panting dyspnœa generally accompanying pneumonia, pleurisy, and some forms of heart-disease. From *croup* it is recognised partly, but not entirely, by the age of the patient; and partly by the character of the dyspnœa, which in croup is *inspiratory*, whereas in asthma it is mainly *expiratory*. This characteristic also distinguishes asthma from *spasm of the glottis* and the various forms of *laryngeal dyspnœa*. The diagnosis from *emphysema*, which is so often mixed up with spasmodic asthma, is founded chiefly on the paroxysmal character and violence of the asthmatic dyspnœa; and on the complete freedom of the intervals, the dyspnœa of emphysema being more or less permanent.

Aneurism of the aorta and other *mediastinal tumours* often give rise to symptoms so exactly simulating spasmodic asthma as to make the diagnosis difficult, and this is to be accounted for by these tumours pressing on the pneumogastric and its branches, and thus inducing an asthmatic spasm. These cases are, as a rule, however, accompanied by a certain amount of stridor arising from laryngeal spasm, not present in asthma, and this symptom is often of great diagnostic value in obscure cases. As the tumour enlarges, it causes greater pressure on the lungs, trachea, œsophagus, sympathetic ganglia, or other structures, and produces shrill cough, dysphagia, difficulty of inspiration, pain in the chest, impulse in the thoracic wall, and other noted aneurismal symptoms. Moreover, certain physical signs become evident, *e.g.* dulness over the first portion of sternum or to the right of it, or between the scapulæ; tubular sounds and bronchophony close to the sternum, or above one or both scapulæ; or some form of bruit or murmur in the course of the aorta. These and other symptoms and signs contrast sufficiently with those of spasmodic asthma, to make the diagnosis from developed aneurism comparatively easy.

In some cases of *renal disease* a form of dyspnœa appears, which is occasionally marked by paroxysmal features, and has been mistaken for spasmodic asthma. Renal dyspnœa differs, however, as a rule, in being more continuous; and in having for its origin œdema of the lung rather than bronchial spasm.

PROGNOSIS.—The question of recovery in cases of asthma depends to a certain extent,—

Firstly, on the possibility of the removal of the exciting cause;

Secondly, on the age of the patient;

Thirdly, on whether the attacks increase or not in frequency;

Fourthly, on the condition of the lungs and breathing in the intervals.

If the patient be young (say, under fifteen), the

chest well-formed, the attacks tending to diminish in frequency and intensity, and the lungs free in the intervals, a most hopeful prognosis can be given. If, on the other hand, the patient be middle-aged, the attacks increasing in number and severity, and the breath more or less short in the intervals, we may conclude that there exists a considerable amount of permanent emphysema, which renders the prognosis of an unfavourable character. In every instance the detection and removal of the exciting cause or causes, as the case may be, exercise a chief influence over the prognosis.

Treatment.—The principal difficulty in the treatment of asthma lies in clearly ascertaining the origin of the irritation, and when this is discovered two great principles should guide us, namely, first, to avoid or remove the exciting cause; secondly, to allay and prevent the spasm.

Many of the cases arising from direct causes, as from dust, chemical vapours, &c., are cured by simple avoidance of the exciting cause. Where bronchial inflammation induces the spasm, the inflammation must be subdued by salines and expectorants, combined with some anti-spasmodic, as belladonna, henbane, or stramonium. In more chronic instances, where some thickening of the walls of the larger bronchi and enlargement of the bronchial glands exist, iodide of potassium in doses of grs. iii. to x., has been found beneficial when persisted in for long periods. Where the attacks depend on a morbid state of blood, as that associated with gout, syphilis, renal disease, or connected with skin-disease, treatment must be directed to the condition of this fluid, which, if improved, will no longer induce bronchial spasm. Arsenic proves of signal service in asthma co-existing with eczema, psoriasis, and other skin-affections.

Where heredity is the predisposing cause, the origin of the disease lies generally in defective development of the frame or of the lung-structure of the patient: for such persons gymnastic exercises, swinging on the trapeze, and other means of expanding the upper part of the chest and correcting the asthmatic stoop are to be employed, combined with cold sponging and as much outdoor life as possible, with walking and riding in moderation. The tendency to catarrh is thus lessened, and the frame of the patient developed and fortified. In a large number of cases, as, for instance, those arising from climatic influences, we have to treat a simple neurosis, and to allay the spasm either by climatic or by medicinal means, of which the former is often the more important, and, owing to the leading part played by the idiosyncrasy of the patient, generally the most difficult. In obstinate cases the doctrine of contrasts appears the only safe one. Where the disease has been contracted in a moist climate, a dry one must be tried; if in an inland district, the seaside must be resorted to; but for by far the majority of asthmatics the atmosphere of large towns is suitable, and the smokier the air and the closer the streets the more good do the sufferers appear to receive. London, Glasgow, Birmingham, and Bristol are all favourable resorts for cases of neurotic asthma: and the points of difference between their atmospheres and that of the country consist, (1) in dryness; (2) in deficiency of oxygen; and (3) in excess of carbonic acid and carbon: all of which peculiarities appear to exercise a sedative effect on the neurosis. Damp, whether of soil or atmosphere, is usually found to be hurtful, and is one of the chief exciting causes of asthma.

The *medicines* most useful in asthma are anti-spasmodics, either stimulant or sedative: the former, including alcohol, strong coffee, spiritus ætheris, and nitrite of amyl, will prove more efficacious where emphysema is present; the latter comprise stramonium, belladonna, Indian hemp, lobelia, tatula, tobacco, opium with its salts, and many other drugs. These may be taken internally in the form of extracts or tinctures; or smoked in pipes or as cigarettes; or inhaled as vapour diffused through the room by burning papers or pastilles containing them. A popular and often reliable remedy is the vapour arising from the combustion of nitre-paper. In the severest attacks the patient can neither smoke nor swallow, and in this difficulty of introducing medicines into his system we find the hypodermic injection of atropine, morphia, and chloral proves effectual; but if emphysema be present, or if the pulse be weak, it must not be attempted. Chloroform often acts like a charm in the worst case, and after inhaling 20 to 60 minims the patient will gain the sleep which has been denied to him for hours, or even days; but the effect is generally transitory, and the use of the remedy not free from risk. Ether is safer, but not so effective. Chloral-hydrate in doses of 15 to 20 grs., repeated every four hours until the spasm subsides, has produced not only temporary, but even permanent good in a large number of asthmatic cases, and if watched, may be persisted in for some time. In the writer's hands it has proved the most successful remedy. In the use of anti-spasmodics we must avoid judging the effects of one from the failure of another of the same class; but in difficult cases we must try each in succession—for it often happens that the successful remedy is only arrived at after repeated trials.

Certain mineral waters, and especially those of Mont Dore and the Pyrenean sulphur springs of Eaux Bonnes, Eaux Chaudes and Cauterets, are reputed to exercise a beneficial influence over asthma, but they have not been successful in the writer's experience, and it is more probable that they relieve by reducing the catarrhal symptoms than that they either allay the spasm or prevent its recurrence.

Compressed air baths at pressures varying from $3\frac{1}{2}$ to 7 inches of mercury, and lasting two hours, have afforded considerable relief. *See* Air, Therapeutics of.

The *dietetic* treatment varies in individual cases, but as a rule asthmatics should dine early, and for the rest of the day limit themselves to liquid food, such as beef-tea, soups, and milk, combined with such an amount of stimulant as may be necessary, thus avoiding any distension of the stomach and intestines before retiring to rest. The diet should consist of brown bread, toast, and biscuits—excess of starch in any form being studiously avoided—a fair supply of plainly

cooked meat, fish or poultry, and a limited amount of vegetables and fruit, care being taken to select only the most digestible of each class.

C. Theodore Williams.

ASTIGMATISM — ASTIGMISM (ἀ, priv., and στίγμα, a spot or point).—Want of symmetry in the anterior refracting surfaces of the eyeball, in consequence of which rays of light proceeding from a point cannot be brought to a focus upon the retina as a point, but only as a diffused spot. *See* Vision, Disorders of.

ASTRINGENTS. — Definition. — Medicines which cause the contraction of tissues.

Enumeration.—The chief astringents are Nitrate of Silver; Sulphate of Copper; Sulphate of Zinc; Acetate of Lead; Perchloride of Iron; Alum; Tannic and Gallic acids, and vegetable substances containing them, such as Oak Bark, Galls, Kino, and Catechu; and Dilute Mineral Acids. Some authors also include in this class of remedial agents such articles as Ergot of Rye, which contracts the blood-vessels and lessens hæmorrhage after it has been absorbed into the blood, although it has no local astringent action.

Action.—With the exception of gallic acid, the substances already mentioned coagulate or precipitate albumin. Dilute mineral acids do not coagulate albumin, but precipitate many albuminous bodies from the alkaline fluids by which they are held in solution. When applied to a surface from which the epidermis has been removed, the other astringents combine with the albuminous juices which moisten this surface, as well as with the tissues themselves, and form a pellicle more or less thick and dense, which in some measure protects the structures beneath it from external irritation, at the same time that they cause the structures themselves to become smaller and more dense. On a mucous membrane they have a similar action, and they lessen its secretion. It was formerly supposed that their action was partly due to their causing the blood-vessels going to a part of the body to contract, thus lessening the supply of fluid to it; as well as to their effect on the tissues themselves. But experiment has shown that, while nitrate of silver and acetate of lead possess this power, perchloride of iron and alum do not, and that tannic and gallic acids actually dilate the vessels. The astringent action of these latter drugs must therefore be exerted upon the tissues.

Uses.—Astringents may be employed *locally* in various forms. In the solid form, as a powder, or in various preparations such as lotions, ointments, plasters, glycerines, &c., they are applied, especially the metallic astringents, to wounds and ulcers for the purpose of reducing the size and increasing the firmness of exuberant granulations, as well as of protecting the surface by forming a pellicle over it. They are used to lessen congestion and diminish the secretion of the various mucous membranes —as a lotion to the eye and mouth; as a gargle or a spray to the throat; in the form of an injection to the nose, urethra, and vagina; and as a suppository to the rectum. Administered internally several astringents have a powerful effect in checking diarrhœa, and certain of them may have a local action upon the stomach and intestines.

The *remote* action of such astringents as acetate of lead and gallic acid, when absorbed into the blood, in lessening hæmorrhage, is made available in the treatment of hæmoptysis, hæmatemesis, hæmaturia, and loss of blood from other parts of the body.

T. Lauder Brunton.

ASTURIAN ROSE.—The rose or erythema of the Asturias; one of the numerous synonyms of Pellagra—*Mal de la rosa; Lepra Asturiensis; Elephantiasis Asturiensis.* *See* Pellagra.

ATAVISM (*atavus*, a grandfather) signifies the inheritance of a disease or constitutional peculiarity from a generation antecedent to that immediately preceding.

ATAXIA
ATAXIC } (ἀ, priv., and τάξις, order). — Terms which originally meant any irregularity or disorder, but are now specially applied to irregularity of associated or co-ordinated muscular movements. The noun is frequently used as synonymous with the disease known as Locomotor Ataxy. *See* Locomotor Ataxy.

ATELECTASIS (ἀτελής, imperfect, and ἔκτασις, expansion).—Absence or imperfection of the expansion of the pulmonary alveoli which normally takes place at birth, the lungs thus remaining more or less in their fœtal condition. *See* Lungs, Collapse of.

ATHEROMA. *See* Arteries, Diseases of.

ATHETOSIS (ἄθετος, without fixed position).—Definition.—A name given by Dr. Hammond of New York to a condition in which the hand and foot are in continual slow irregular movement, and cannot be retained in any position in which they may be placed.

Description.—The special character of the movements in athetosis is that they are slow and deliberate. They usually affect the arm and leg on one side only. Voluntary power is retained, but is interfered with by the slow spasm. The fingers are irregularly flexed and extended: at one moment they spread wide apart, the thumb being overstretched; thereafter first one, then another is bent in to the palm, and again extended. The movement can be arrested for a moment in certain positions by the will, but is renewed with increased force. The foot is usually inverted; the toes being flexed or extended, but in less constant movement. The spasm may cause pain. The muscles sometimes become hypertrophied. The movements in some cases cease during sleep, in others they do not. Sensation is often, but not always impaired. The onset of this condition is usually sudden, and in some cases with a convulsion. The subjects have been generally in middle life.

Athetosis differs from the spastic contracture so common after hemiplegia in children in the slowness and spontaneity of the movements; but the two conditions are probably very closely allied. It cannot be regarded as a distinct disease. Typical athetosis may succeed hemiplegia.

Pathology. — It is probable that, as Dr.

Hammond suggests, the seat of the mischief in athetosis is the corpus striatum or optic thalamus. The sudden onset of the disease, and the slight affection of sensation, render it probable that a lesion damaging, but not destroying, a portion of one of these nuclei, leads to a perverted action of the nerve-cells, so that abnormal motor impulses are originated, and those transmitted from above disturbed—'irradiated' (Nothnagel). Charcot believes that all post-hemiplegic choreoid movements depend on the implication of fibres outside the optic thalamus. In a case of simple ataxy after hemiplegia—an analogous condition,—the writer has found a cicatricial sclerosis extending across the optic thalamus, and probably left by a patch of softening.

Prognosis.—This is unfavourable, but the slighter cases improve and may even approximately recover.

Treatment.—Nervine tonics and sedatives are the remedies chiefly indicated. Of the former arsenic, and of the latter Indian hemp, do most good; bromides are also useful. The continuous current is perhaps the agent which affords most distinct relief. In one well-marked case under the writer's care the spontaneous movements ceased entirely after some months' galvanisation. The positive pole may be placed on the spine or brachial plexus, the negative on the muscles involved. The action of the continuous current is probably in part direct, in part reflex, lessening by the peripheral impression the over-action of the centre, as do some other peripheral impressions.

W. R. Gowers.

ATONIC } (ἀ, priv., and τόνος, tone).—
ATONY } Terms implying want of tone, power, or vigour, and associated either with such a condition of the system generally, or of particular organs, especially those which are contractile.

ATRESIA (ἀ, priv., and τίτημι, I pierce).—Absence of a natural opening or passage, whether congenital or caused by disease.

ATROPHY, GENERAL.—Synon.: Marasmus.

Definition.—Atrophy means, etymologically, simply want of nourishment (ἀ, priv., and τροφή, nourishment), but the term is commonly applied to the condition resulting from want of nourishment, namely, wasting or diminution in bulk and substance, even though this may have been produced by some other cause, and even though the supply of nutritive material may have been abundant. *General atrophy* is used to denote wasting in which the whole body participates. All acute diseases, if severe, are accompanied by emaciation, for at such times nutrition is temporarily interfered with. The use of the word 'atrophy' is, however, confined, as a rule, to cases where the interference with nutrition has been gradual, and the loss of flesh consequently slow.

Ætiology.—Atrophy is common enough at all periods of life. In infants and children it is due, in the majority of cases, to chronic functional derangements which interfere with the digestion and elaboration of food. Less frequently it is a consequence of organic disease. In adults general atrophy seldom results from any other cause than organic disease, and functional disorder as a cause of serious wasting is the exception. In old age atrophy is a common consequence of the degenerations of tissue which accompany the decline of life. The interference with nutrition may, however, be aggravated by the presence of disease.

In *infants under twelve months old* there are four principal causes to which chronic wasting can usually be referred, namely, unsuitable food; chronic vomiting (gastric catarrh); chronic diarrhœa (intestinal catarrh); and inherited syphilis. Bad feeding, by setting up a chronic catarrhal condition of the stomach and bowels, is a frequent cause of both vomiting and diarrhœa, but it may produce atrophy without either of these symptoms. When an infant is fed, for instance, with large quantities of farinaceous matter—a form of food which is alike indigestible and innutritious—a very small part only can enter as nutriment into the system. The remainder passes down the alimentary canal, and is ejected at rare intervals in an offensive putty-like mass or in hard roundish lumps. The child, therefore, although overloaded with food, is really under-nourished, and loses flesh as long as such a diet is persisted in. If, as often happens, diarrhœa or vomiting be set up by the irritation to which the digestive organs are subjected, wasting is more rapid and the danger of the case is increased. Any form of bad feeding, and not only excess of farinaceous matter, will produce this result. Wasting, indeed, will be found in every case where the food selected is unfitted for the child, and thus it is not unfrequently seen in infants who are fed upon milk and water alone. The casein of cow's milk is difficult of digestion by many infants on account of its tendency to coagulate into a large firm clot like a lump of cheese. In this respect it differs from the curd of human milk, which forms light small floccu lent coagula, and is digested without difficulty. Special preparation is therefore generally required to render cow's milk a suitable diet for a young child.

It is not only, however, unsuitable food which is a cause of atrophy in infants. Catarrh of the stomach and bowels may be present, although the feeding is in all respects satisfactory. Infants are excessively sensitive to chills, and catarrh of their delicate digestive organs is easily excited. Now, catarrh of a mucous membrane is always accompanied by an increased flow of mucus, and this alkaline secretion in excess acts as a ferment and sets up decomposition of food. A sub-acute gastric catarrh from this cause is not rarely seen in new-born infants, who thus are rendered for the time incapable of digesting even their mother's milk. In such cases the fault is usually attributed to the milk, which is said to be unsuited to the child; and the mother is compelled, much against her will, to wean her baby and feed it in a different way. So long as the catarrh continues, however, no food appears to agree, and the child often after a time dies exhausted.

Between *one and three years* atrophy is commonly associated with rickets. In these cases

the wasting is noted chiefly about the chest and limbs, for the belly is large and swollen from flatulent accumulation. At this age children are still liable to waste from catarrh of the stomach and bowels: indeed, rickets is itself often complicated by such derangements. Cancer of the internal organs is also sometimes found at this time of life, and is attended with extreme emaciation.

After the age of three years caseous enlargement of the mesenteric glands becomes a cause of wasting.

After the fifth or sixth year chronic pulmonary phthisis begins to appear. Cases of heart-disease as a result of acute rheumatism are also more frequently seen. Diabetes, too, is sometimes met with. All these diseases may produce much interference with nutrition.

From the time that the child begins to take other food than that furnished by his mother's breast, he is liable to worms in the alimentary canal. The presence of worms is frequently accompanied by loss of flesh, not, perhaps, so much on account of the parasites themselves, as on account of the derangement of the digestive organs which is associated with them. Emaciation due to this cause may sometimes be extreme.

In the adult atrophy is rarely the result of mere functional derangement, but is almost invariably a sign of serious organic disease. All chronic ailments are not, however, accompanied by marked wasting. Purely local diseases lead to little loss of flesh unless they affect some part of the digestive apparatus, or of the glandular system which is concerned in the elaboration of nutritive material; or otherwise directly influence the processes of nutrition. Thus, emaciation quickly results from gastric ulcer or chronic dysentery, but chronic pneumonic phthisis may produce little diminution in weight if there is no pyrexia, and if the case is not complicated by diarrhœa or profuse expectoration. The most marked atrophy is produced by the so-called constitutional diseases, such as cancer and syphilis in the third stage; by those which set up a persistent drain upon the system, such as severe albuminuria, chronic hæmorrhages, and long-continued suppurations; or by those which directly impede the passage of nutritive material into the blood: and in the latter class of diseases, influences which act directly upon the thoracic duct, such as obstruction to its passage from pressure by aneurism and other tumours, must not be overlooked. There is a form of atrophy sometimes seen in hysterical females, depending upon disordered innervation, in which the most extreme emaciation may be reached. Such cases are marked by a dislike to food which may amount to absolute loathing.

Symptoms.—The symptoms of general atrophy are loss of flesh, loss of colour, and loss of strength, combined with other special phenomena arising from the particular disorder to which the impairment of nutrition is due.

Anatomical Characters.—The most marked post-mortem appearance in this condition is diminution or loss of fat, especially of the subcutaneous adipose tissue; and this is accompanied by wasting of the tissues and organs generally. The histological elements are reduced in size without undergoing, as a rule, actual numerical diminution. With the atrophy is often associated a certain amount of fatty degeneration.

Treatment.—The treatment of general atrophy consists in removing, if possible, the impediment to efficient nutrition. In the case of a child the diet must be selected with care. Excess of farinaceous food is to be avoided, and cow's milk can be diluted, if necessary, by admixture with thin barley water. Any gastric or intestinal derangement must be at once remedied, plenty of fresh air should be obtained, and perfect cleanliness strictly enjoined. In an adult the disease which is the cause of the malnutrition must be sought for and submitted to treatment. Efforts should be made on the one hand to arrest any drain upon the system; and, on the other hand, by a judicious arrangement of the dietary, and by attention to the eliminatory organs, to remove all obstacles to the entrance of nourishment. Even in cases of organic and incurable disease much benefit may often be derived from due observance of physiological laws.

Eustace Smith.

ATROPHY, LOCAL.—This condition signifies atrophy of a *part* of the body, which may be apparently congenital, or may be produced by various causes acting during life. It will be convenient to consider local atrophy according to the several forms which are met with.

Congenital Atrophy is that condition in which some part of the body never reaches its full standard of size. It is more correctly denominated *arrested growth* or *congenital smallness*. When the whole of one side of the body is thus affected, a marked and permanent disproportion between the two sides results. This *hemiatrophy* is, in theory, difficult to distinguish from hypertrophy of the opposite side, but mostly the paralytic or enfeebled state of the atrophic side shows it to be abnormal. The limbs are most strikingly implicated, while the corresponding side of the face and head is sometimes similarly, sometimes conversely affected. In many cases atrophy of the opposite half of the cerebrum was found on post-mortem examination. The same condition may be partial—*hemiatrophia partialis*—and it then chiefly affects the face, or some part of the territory of the fifth cranial nerve. These conditions must be ascribed to some perversion of innervation occurring during development. Other congenital atrophies, *local* but not *hemi*-atrophic, are more probably referred to obstruction of blood-vessels during the same process. The defective development of the brain in cretinism has been attributed to the pressure of an enlarged thyroid upon the carotid arteries.

Physiological Atrophies.—These form a distinct class, where atrophy of a part of the body takes place in the ordinary course of development. Such are the wasting of the thymus gland in early life, of the mammæ and sexual organs after middle age. Most commonly the atrophy is here closely connected either with the involution or perhaps the development of some correlated organ; but it is not possible

to say what the nature of this connection is, whether one of nutrition or of innervation.

Acquired Atrophies.—The conditions thus distinguished possess most interest for the practical physician. Wasting of any part of the body during life, when not physiological, usually depends either upon some interference with the blood-supply, or some disturbance of innervation; but to these must be added, in the case of organs which have an active and continuous function, disuse or over-stimulation. Deficient blood-supply, which causes atrophy, may be produced by the obstruction of a nutrient artery, especially if it be gradual, since sudden blocking will produce more complicated phenomena. Constant pressure is a cause of atrophy, because it interferes both with the blood-supply, and with the vital actions of the tissue-elements. Intermittent pressure, on the other hand, by causing hyperæmia, is more likely to lead to hypertrophy. Moreover, inadequate renewal of blood, that is, filling of the vessels, even to excess, with venous blood, or venous engorgement, though at first it may cause enlargement, mostly leads to atrophy in the end; as is seen in the granular induration of liver and kidneys caused by disease of the heart obstructing the circulation. Many forms of atrophy in old age are clearly dependent upon senile obstruction of the arteries, for example, that of the skin, spleen, and kidneys. The instances of atrophy from disturbed innervation are less easy to discriminate, except where there is actual paralysis. In two distinct diseases, however, *progressive muscular atrophy* and *infantile* or *essential paralysis*, loss of power in the muscles is followed by a remarkable wasting, far more rapid than that which results from disuse alone. Division of the nerve of a limb produces rapid wasting of the muscles no longer used, and this is accompanied in the end by some diminution in the size of the bones and accessory parts. Local atrophy of the skin is sometimes seen in regions limited by the distribution of a nerve, especially some branch of the fifth; and more extensive atrophy of one side of the face or head, equally marked out by nervous distribution, and resembling some cases of congenital atrophy, has also been, though very rarely, observed. These facts raise the interesting question whether there are 'trophic nerves.' Without discussing this question, it may be pointed out that the nerves which delineate an atrophic region are always motor or mixed branches, never solely sensory.

Disuse produces atrophy only in organs whose functions are active and constant, such as nerves and muscles. Nervous tissue wastes constantly, and sometimes rapidly when currents cease to traverse it. This is seen not only in the nerves of paralyzed limbs, but even in the nerve-centres, where any interruption of the nervous channels, either above in the cerebrum, or below in the nerve-trunks, is followed by degeneration, ending in atrophy, of the whole nervous tract leading from the cerebral cortex to the peripheral termination—so-called *secondary degeneration* of the cord. In muscular tissue the wasting is almost as constant, but hysterical paralyses make an exception, the helpless limbs preserving their nutrition in a surprising manner. In organs whose functions are intermittent or periodic, disuse does not appear necessarily to produce atrophy, as is seen in the ovaries, testicles, and mammæ.

That excessive stimulation or over-work may produce atrophy is seen in degenerative diseases of the nerve-centres arising from undue mental activity; and of the sexual organs from excessive indulgence.

Unexplained Atrophies.—Cases of local atrophy occur of which it is impossible to give any satisfactory explanation. Such are the conditions known as linear atrophy of the skin; some remarkable cases of atrophy of bone, especially of the skull (*fragilitas ossium*), and of some parts of the cerebrum. We may have to attribute to changes of the latter class just mentioned, certain peripheral atrophies, without being able to account for the original lesion.

It is possible that deficiency of special kinds of food may lead to atrophy of special organs—thus deficiency of lime may make the bones soft, and deficiency of iron arrest the development of blood-corpuscles; but even these familiar instances must be accepted with a little reserve. In the same way it is still doubtful whether any special drugs, such as iodine, can produce atrophy of special glands.

Pathology.—Wasting may occur simply, or as a consequence of change of substance, or from the intrusion of some new material; in other words, there may be *simple* atrophy, atrophy from *degeneration*, or atrophy by *substitution*. The first is probably rare; generally some change of substance occurs. The most frequent degenerative process is fatty degeneration; the albuminous substance being converted into or replaced by fat, which, if afterwards absorbed, leaves a void. Organs thus affected may be apparently enlarged, though the original substance is wasted. Atrophy from substitution is seen when the connective tissue of an organ, for instance, increases, compressing and destroying the other tissue-elements, and these not being renewed when the newly-formed connective-tissue is absorbed, the whole organ is diminished in bulk. This is seen in all the changes called cirrhosis or fibroid degeneration, as in cirrhosis of the liver and kidneys.

Treatment.—No general rules can be laid down for treating all cases of local atrophy. Where the blood-supply is deficient, we have rarely any means of supplementing it; where innervation is at fault, it is seldom under our control. In general, harm rather than good results from any attempt to attract blood by artificial irritation. In the case, however, of atrophy from disuse of the nervo-muscular system, a line of treatment, and more especially of prophylaxis, is very clearly indicated; that is, to keep the muscles in exercise by artificial means, particularly by electricity, or by the processes of friction and kneading, known as passive motion. In this way so much of the atrophy as is due simply to disuse may be checked for the future, and even the past loss reinstated. We shall, moreover, never do harm by attempting to supply some special kind of food which appears to be deficient, as iron for the blood and phosphorus for the bones or nervous system.

J. F. Payne.

AUDITORY NERVE, Diseases of. *See* EAR, Diseases of; and HEARING, Disorders of.

AURA (*αὔρα*, a breeze).—A peculiar sensation, subjective in origin, immediately preceding an epileptic or hysterical convulsion, and named respectively *Aura Epileptica* and *Aura Hysterica*. The word was originally adopted because the sensation is often described as that of the passage of cold air or light vapour from the trunk or extremities to the head; but it has been extended so as to include any phenomenon, whether sensory or motor, that ushers in a fit of epilepsy or of hysteria.

AURAL DISEASES. *See* EAR, Diseases of.

AUSCULTATION (*ausculto*, I listen).—A method of physical examination, which consists in listening over various parts of the body, either by the direct application of the ear (*immediate auscultation*), or by the aid of special instruments (*mediate auscultation*), for the purpose of studying certain sounds produced in health and disease. *See* PHYSICAL EXAMINATION.

AUSCULTATORY PERCUSSION.—A method of physical examination in which the sounds elicited by percussion are studied by means of auscultation. *See* PHYSICAL EXAMINATION.

AUSTRALIA. *See* APPENDIX.

AUTOPHONIA (*αὐτὸς*, itself, and *φωνὴ*, the voice).—A physical sign obtained by studying the modifications of the resonance of the observer's own voice during auscultation. *See* PHYSICAL EXAMINATION.

AUTOPSY. *See* NECROPSY.

AZORES, St. Michael's.—Warm, very moist, equable climate. Mean winter temperature 58° F. Prevailing winds N. and E. *See* CLIMATE, Treatment of Disease by.

AZOTURIA.—A condition of the urine in which there exists an absolute and relative excess of urea, without accompanying pyrexia. *See* URINE, Morbid Conditions of.

B

BACILLUS (from *bacillum*, a little staff) is the name now given to certain filiform *Bacteria* which have assumed much importance of late, principally because of their constant presence in the blood and tissues in splenic fever and malignant pustule. *See* LEPTOTHRIX, and BACTERIA; also PUSTULE, MALIGNANT; and BACCILLI in APPENDIX.

BACTERIA (*βακτήριον*, a rod) are some of the lowest known forms of life. They most frequently exist as minute rod-like bodies, about $\frac{1}{10000}$ inch in length, with a slight median constriction. They may be larger or smaller than this, and may present minor variations in form. They swarm in all putrefying solutions and mixtures of organic matter, and in many fermenting fluids in which the chemical changes are not accompanied by an emission of stinking gases. In fluids belonging to the latter category, the typical *Torula* or yeast-cell may be met with, as well as organic forms strictly intermediate between it and the typical Bacterium. From a chemical point of view, it is admitted that no absolute line of demarcation can be drawn between the intimately related processes of *putrefaction* and *fermentation*; whilst from a biological point of view we are similarly unable to erect any impassable barriers between the organic forms which are found as part of the products of change in putrefying and fermenting fluids respectively. It is unquestionably true that typical Bacteria are most frequently met with in putrefying fluids; whilst, on the other hand, typical Torulæ are only present in some fermenting fluids. But the rather long rod-like bodies, which have been hitherto named *Vibriones*, and the still longer filaments mostly known as *Leptothrix* (*see* LEPTOTHRIX), are unquestionably capable of being derived from ordinary Bacteria in certain media.

In the most highly putrescent fluids Bacteria are usually found to be very small, because, though the total bulk of living things rapidly augments in such fluids, the individual units (in consequence of the frequency with which a process of fission takes place) do not increase in size. In less putrescent fluids, however, where the chemical changes constituting the putrefactive process take place more slowly, the living forms also appear and grow with less rapidity; and owing to the co-existence of a lower frequency of fission or spontaneous division amongst such individual living units, they often attain a larger size. They then appear, according to their length, either as Vibriones or as Leptothrix filaments. These are plain, jointed, or monilated, according as partial segmentation is absent, has taken place rarely, or has occurred so rapidly as to give what would have been a plain filament the appearance of a string of beads.

Concerning the question of the precise relation of organisms to the processes of putrefaction and fermentation, opposite opinions are at present held. Believers in Pasteur's germ-theory maintain that they are invariably the initiators of these chemical processes; whilst those who reject this theory, as being too exclusive, contend that putrefaction and fermentation *may* be initiated in the absence of Bacteria and their germs. Those holding the former view believe that Bacteria are only capable of being derived from pre-existing organisms of like kinds; whilst those who reject it contend that particles of living matter, which develop into Bacteria, may be generated from the organic compounds dissolved in fermentable fluids, and that such particles of living matter are, in fact, just as much products of the fermentative process and of the fluid in which it occurs, as are the gases simultaneously generated therefrom. According to this view, these lowest living units bridge the gap hitherto held to exist between living

and so-called dead matter, and afford an illustration of the natural independent origin of chemical compounds so complex and endowed with such attributes as to win for them the name of 'vital' compounds. (See *Proceedings of the Royal Society*, No. 172, 1876, pp. 149–156.)

Pasteur's 'Vital theory' of fermentation is one of great importance both to chemists and biologists, and it also forces itself upon the attention of medical men, as the parent of another doctrine which has of late assumed great prominence in relation to the science of medicine—the doctrine, namely, that lower organisms allied to those met with in putrefying and fermenting media are causally related to certain morbid processes with which they either do, or are said to coexist. Bacteria and their allies are as uniformly coexistent with a few general diseases and certain local morbid processes as they are with putrefactions and fermentations, so that the same general question as to the precise significance of this coexistence again presses for solution. Are the organic forms associated with such morbid processes the sole causes or inciters of these processes? or are they consequences (*i.e.* concomitant products) of pathological processes which have been *initiated* in their absence? The former view is warmly supported by many who regard Bacteria and allied organic forms as the contagious elements of such communicable diseases; and many of these same pathologists, resting upon analogy, wish to extend their theory, so as to make it applicable to many other communicable diseases with which organic forms have not as yet been shown to be correlative.

Thus, just as certain chemists hold that Bacteria and allied forms are the causes of all fermentations and putrefactions, so certain pathologists either do actually, or are inclined to maintain that Bacteria and allied organisms of common or of special kinds are the causes of all communicable or contagious diseases. According to such chemists all *ferments* are living organisms; and according to such pathologists all *contagia* are allied living organisms.

The coexistence of organisms is one which obtains for almost all fermentations, but only for a few of the communicable diseases, so that any argument deducible from such mere coexistence in favour of the causal relationship of the organisms, is much stronger in the case of fermentations than as regards diseases. Yet, in spite of the almost universal coexistence of organisms with fermentations, it is still necessary for us to ask whether they appear as causes or as effects of these phenomena. From this it may be judged how little the more limited 'facts of coexistence' should be allowed to influence our opinion on the derivative question of the relation of the lower organisms to disease. At least one of the reputed instances in which this coexistence of organisms has been dwelt upon, as showing that they are the causes of the morbid phenomena with which they are associated, has of late been dissipated, since in the case of the small-pox of sheep (*variola ovina*) the alleged organisms are now admitted to have no existence—certain appearances produced in the tissues by preservative media having been mistaken for organisms which have been elaborately described and figured. (See *Proceedings of the Royal Society*, No. 172, 1876, p. 140.) But even if all the alleged cases of coexistence of organisms with morbid processes were real, and if future investigations should show that such facts are more numerous than are at present imagined, still the multiplication of this evidence to any extent will never help us (any more than it has done in the case of fermentations) to solve the real question—whether such morbid processes are only caused and propagated by organisms, or whether they may at times come into existence independently?

The vital or germ-theory of fermentation would be broken down and become untenable whenever it is shown that fermentation can originate independently of the Bacteria and their germs which appear as part of the process. Similarly, the germ-theory of disease would be refuted, if it could be shown that some of the morbid processes in question could originate in the absence of the living organisms which subsequently appear as part of the pathological products. The latter refutation, however, could never be made directly, since no living being could in any circumstance whatsoever be proved —in an experimental sense—to be beyond the possible reach of some of the alleged disease-germs. But inasmuch as this problem is, from its very nature, one which does not admit of experimental proof or disproof in the strictest sense of the term, and because this germ-theory of disease is clearly a derivative doctrine from the germ theory of fermentation, it must stand or fall with the germ-theory of fermentation, which, fortunately, is capable of experimental proof or disproof. The question of 'spontaneous generation' comes, therefore, to be inextricably mixed up with the question of the truth or falsity of the germ-theory of disease, so that the study of the latter to the neglect of the former can only end in the propagation of vagueness and uncertainty. The real question is not as to the extent or frequency of the coexistence of organisms with local or general diseases, but the much more important one as to the nature of their relation to such processes. If they act as invariable and sole causes, then their presence is a matter of the deepest interest and importance. If, on the other hand, the organisms are not causes but rather concomitant products, their presence from a purely medical point of view is of trifling importance. The study of their growth and development would in that case be important only as adding to our knowledge of the structural changes pertaining to the diseases in question. *See Transactions of the Pathological Society*, vol. xxvi., and *Journal of the Linnæan Society*, vol. xiv. *See* also the articles Micrococci; Pustule, Malignant; and Zyme.

H. Charlton Bastian.

BADEN-BADEN in Germany. Thermal saline waters. *See* Mineral Waters.

BADEN in Austria. Thermal sulphur waters. *See* Mineral Waters.

BADEN in Switzerland. Thermal sulphur waters. *See* MINERAL WATERS.

BADENWEILER in Germany. Simple thermal waters. *See* MINERAL WATERS.

BAGNÈRES-DE-BIGORRE in France. Simple thermal and earthy waters. *See* MINERAL WATERS.

BAGNÈRES-DE-LUCHON in France. Thermal sulphur waters. *See* MINERAL WATERS.

BALANITIS — BALANOPOSTHITIS (*βάλανος*, an acorn, and *πόσθη*, the foreskin).—SYNON.: Bastard Clap; Blennorrhagia Balani; Inflammatory Phimosis.

DEFINITION.—Inflammation of the opposing surfaces of the glans and prepuce; sometimes acute—even gangrenous, and sometimes chronic. A purely local affection; frequently, but not necessarily, of venereal origin.

ÆTIOLOGY.—Balanitis is much less common than urethritis, being met with at the Lock Hospital in the proportion of one to twenty-four of the latter. It may be either primary; or consecutive to chancres, syphilitic eruptions, warts, accumulated smegma, variolous pustules, or gonorrhœa. When primary, the common *predisposing* cause is a long, narrow foreskin. Fournier attributes two-thirds of the cases of balanitis to a long prepuce with insufficient cleansing; about one-third to irritation by chancres and gonorrhœal pus; and a very few to other causes.

SYMPTOMS.—The symptoms of balanitis depend on the intensity and extent of the inflammation. In the simplest form there is heat and itching of the furrow, slight redness of that part, with a milky or yellowish secretion. When the inflammation is more severe and extended, swelling and pain are added, the other symptoms are more marked, and characteristic excoriations appear. They are irregular, shallow, never extending more deeply than the epithelium, but often coalescing into large raw chafings. An abundant yellowish-green matter of offensive odour bathes the surface. When the urine trickles over these excoriations there is severe smarting pain. If still further irritated, the foreskin swells enormously, is divided at the free border by deep creases, and can no longer be turned back. Aching, smarting, great tenderness, and painful erection, often accompanied by constitutional disturbance and fever, are present.

COMPLICATIONS.—The cellular tissue and the lymphatic ducts of the foreskin and sheath, or the lymphatic glands, may inflame to suppuration, to ulceration, and, in persons enfeebled by any cause, even to gangrene. Sloughing begins on the inner surface of the foreskin at the upper part; seldom to much extent, though the whole prepuce, except the frænum, may be lost, and when cicatrisation sets in the organ appears circumcised. Paraphimosis is caused by imprudent retraction of a swollen foreskin. Warts keep up chronic posthitis of the furrow. Adhesions, usually at the corona and the furrow, may attach the prepuce completely to the glans. Thickening and phimosis are not uncommon after repeated attacks.

COURSE.—The duration of balanitis depends on the anatomical condition of the parts. When remedies can be easily applied, it is not more than three or four days. With phimosis, the course is severe, and the duration is indefinite; even when limited to the furrow, posthitis is often obstinate.

DIAGNOSIS.—This is easy when the parts can be exposed. *Herpes* is distinguished from balanitis by small grouped round ulcers, limited to one or two points of the mucous surface, without general congestion. *Simple chancre* has well-defined undermined edges and a spongy surface. The *syphilitic sore* has the indurated base and enlarged lymphatic glands. When there is phimosis, the discharge may come from the urethra or from a chancre. If from the urethra, it can be usually seen escaping thence, and there is pain along the penis, with other signs of urethritis. A chancre under the foreskin is betrayed by a hard and tender point, and after a few days consecutive sores usually appear at the orifice of the prepuce.

PROGNOSIS in the primary form is always good. If the complaint is secondary or symptomatic, gangrene may result.

TREATMENT.—The chief indication is to keep the inflamed surfaces separate. After washing and thoroughly drying, the excoriations should be touched with a 10-grain solution of nitrate of silver, and a bit of dry lint laid on the glans before the foreskin is drawn forward. If there is phimosis, frequent injections of tepid water, and twice daily of a 5-grain solution of nitrate of silver must be thrown to the farthest part of the foreskin with a long-nozzled syringe. Leeches to the groins, and opium internally, as well as in injections, relieve pain. Acupunctures give vent to simple œdema, but tend to accelerate gangrene with brawny tension and erysipelatous redness. Incisions, if needed, should be free; one on each side, carried quite back to the furrow. The upper half of the foreskin can then be easily turned back, and the subsequent deformity is less than if the foreskin is divided at the dorsum. In paraphimosis, before replacing the swollen foreskin, the tension should be relieved by acupuncture and astringent lotions, or by incisions if needed. BERKELEY HILL.

BALDNESS.—SYNON.: Alopecia.

DESCRIPTION.—Baldness or loss of hair presents an extensive range of variation in degree, from moderate thinness of the hair, such as occurs in *Defluvium capillorum*, to complete baldness—*Alopecia calva* or *Calvities*, the latter not limited to the scalp alone, but involving eyebrows, eyelashes, beard, and every hair of the body. Instead, however, of being *general*, baldness may be *partial*, affecting more or less of the surface of the scalp for example, the summit and forehead in men, and the summit and occiput in women. One remarkable form of partial baldness has been denominated *Alopecia areata*, or simply *Area*, and as this was described by Celsus, it has likewise been called *Area Celsi*. Area occurs suddenly, and is a mere falling-off of the hair over a space of circular figure; there may be one or more of such Areæ, and sometimes Area is only the beginning of Calvities. Area is likewise occasionally met with in the whiskers and beard.

PATHOLOGY.—The pathology of Alopecia is a loss of nutritive power of the skin, sometimes progressive and consequent on advancing age, as in general baldness; and sometimes limited to a nerve-district of small extent, as in Area. This fact is very evident in the latter form, inasmuch as, conjoined with the sudden dropping-out of the hair, the integument is pale and thin, poorly nourished, somewhat anæsthetic, and thinner in the centre than at the circumference; while the hairs which remain at the periphery are altered in structure, clubbed and broken off.

ÆTIOLOGY.—The causes of Alopecia are exhausted nutritive power of the skin; nerve paresis in the case of Area; syphilis; and local injury. The Alopecia of syphilis follows the plan of distribution of its exanthem. Partial Alopecia may result from a blow; from the accidental tearing out of a lock of hair; from the sting of a bee; from nervous shock; or from other causes.

TREATMENT.—This consists in the restoration of nerve-power and nutritive power; and in local stimulation. The best applications for the latter purpose are the stimulating liniments of the British Pharmacopœia; *e.g.* liniment of ammonia, compound camphor liniment, and the liniments of chloroform and mustard; or the acetum cantharidis properly diluted for general Alopecia, or applied with a brush in its concentrated form for Area. In the treatment of the latter, ammonia, turpentine, and the compound tincture of iodine are likewise useful; while for syphilitic Alopecia the white precipitate ointment with camphor is the best local application, conjoined with an anti-syphilitic constitutional treatment. ERASMUS WILSON.

BALNEOLOGY (*βαλανεῖον*, a bath, and *λόγος*, a word). A scientific exposition of all that relates to baths and bathing. *See* BATHS and HYDROTHERAPEUTICS.

BALNEOTHERAPEUTICS (*βαλανεῖον*, a bath, and *θεραπεύω*, I heal). That department of therapeutics which deals with the application of baths in the treatment of disease. *See* BATHS and HYDROPATHY.

BARBADOES LEG. A synonym for Elephantiasis. *See* ELEPHANTIASIS.

BARBIERS. A synonym for Beriberi. *See* BERIBERI.

BARÉGES in France. Thermal sulphur waters. *See* MINERAL WATERS.

BASEDOW'S DISEASE. A synonym for Exophthalmic Goitre. *See* EXOPHTHALMIC GOITRE.

BATH in Somersetshire. Simple thermal and earthy waters. *See* MINERAL WATERS.

BATHS.—Baths may be regarded as *simple*; and *composite, medicated*, or *artificial*. They may be used in the form of liquid, vapour, or air. We shall consider them under these heads in the following description:—

A. SIMPLE BATHS.—1. **Simple Liquid Baths.**

1. *The Cold Bath.*—By a cold bath is meant the immersion of the body in water below the temperature of 70°. Anything below 50° is considered a very cold bath. The first effect of the bath is a sensation of cold amounting almost to shivering, with slight gasping for breath. If the bath is continued for more than two or three minutes, the temperature of the skin is diminished; and if it is protracted, the blood and the subjacent tissues lose a little heat, but this does not generally occur till after quitting the bath. If the cold is intense and prolonged, there is a certain degree of numbness of the skin; while the pulse becomes small, and may fall from ten to twenty beats in the minute. After a short time (the colder the water the shorter), reaction takes place, bringing redness to the skin and increase of temperature, with a certain amount of excitement; but if the bath be continued, the depression returns. The immediate action of the cold bath is to cause the capillaries to contract and repel the blood from the surface, while by its operation on the peripheral extremities of the nerves, it acts upon the central nervous system. In its more remote effects, the cold bath accelerates the transmutation of tissues, augmenting the excretion of carbonic acid and of urea from the system, and, as a consequence, increasing the appetite.

The body is usually immersed at once in cold water, but the shock of this may be diminished by first using tepid water, and then gradually adding cold to it.

The effect of a cold bath depends much on its duration. Brief immersion, that is for three or four minutes, makes both the depressing and the exciting action less; a longer duration, say of ten to fifteen minutes, increases both actions; but if the bath be very protracted, the continued abstraction of heat produces depression only The effects of a cold bath are less intense, if the bather is able to keep himself in motion, and especially if he swims.

2. *The Warm Bath.*—A warm bath of 96° to 104° produces no shock to the system; it causes a moderately increased flow of the circulating fluids to the surface, augmenting the frequency of the pulse; and scarcely affects the respiration. There is not the depression or the excitement of a cold bath. It rather retards the transmutation of tissues. With a hot or very hot bath—from 104° to 114°, the central nervous and circulatory systems are more affected. The frequency of the pulse increases greatly. The respiration becomes anxious and quickened. The skin is in a hyperæmic condition, and a free perspiration breaks out.

3. *The Tepid Bath.*—Tepid baths of the temperature of 85° to 95°, are intermediate between cold and warm. Their effects seem to be confined to the peripheral extremities of the nerves, and they do not excite the nervous centres or the circulatory system. Neither the pulse nor the excretions and secretions are affected. As no heat is confined in the system or taken from it, there is no reaction, and the animal temperature is unaltered.

It need scarcely be said that drying and rubbing after a bath materially assist its action on the skin; or that, according to circumstances, it may be convenient to order a whole bath, a hip-bath, or a slipper-bath. The foot-bath is a very useful and convenient one, especially when some stimulant substance is added to the simple water.

Wet packing and the various processes of hydropathy, and those powerful agents hot and cold affusion, whether as shower-baths or as douches, are described in the article on HYDROPATHY.

The *duration* of a bath must depend on a variety of circumstances, for instance, on the age and constitution of the patient, on the nature of his malady, and on the temperature of the bath. It may vary from a few minutes to many hours. A very hot or a very cold bath can be supported for a much shorter time than a tepid one.

ACTION AND USES.—Cold baths are indicated for the strong, for youth, and for manhood; warm baths for the delicate, for women, for early childhood, and for old age. Tepid baths are suitable for almost all constitutions, sexes, and ages. Cold baths may in a general way be considered tonic and bracing; they are useful when judiciously employed in many nervous affections, as in chorea and hysteria, and they are the best of all for general hygienic purposes. Of late years they have been specially employed in the treatment of fever (*see* article TEMPERATURE). The great value of warm baths, besides their hygienic employment, as better detergents than cold ones, is in soothing and reducing excitement; in relieving spasms, such as colic and retention of urine; in the convulsions of children, combined with the affusion of cold water on the head; in cases of gout and rheumatism; and generally when action on the skin is desired. Where prolonged immersion is wanted, tepid baths are indicated, as in calming many chronic nervous disturbances, and in many cutaneous affections.

As to contra-indications, all baths, and especially prolonged and even tepid baths are not suited for the asthenic. Both hot and cold baths are to be avoided where there is a weak, fatty heart, or any tendency to apoplexy. No one should ever enter a cold bath when exhausted, and such baths are also contra-indicated when there is a tendency to congestion of internal organs. Under such circumstances a warm bath is usually both safer and more refreshing. The too long and too frequent use of hot baths is debilitating.

II. **The Simple Vapour-Bath.**—A vapour-bath is one in which the skin is exposed to the action of hot water presented in the form of vapour. The vapour-bath may be taken in a box with the head included or not; or in the more common form of the Turkish or Russian baths, where a large room is filled with vapour, and where therefore the vapour is inhaled; or by vapour obtained from a small and suitably constructed apparatus, which vapour may be diffused over the whole body or directed to a particular part. A very simple apparatus for the vapour-bath may be prepared by placing under a chair a shallow earthenware or metallic pan, containing boiling water to the depth of three or four inches, and from which abundant vapour can be obtained by placing in it one or two red-hot bricks. The patient sitting on the chair, surrounded by blankets and other suitable covering, will receive the full benefit of a vapour-bath. Vapour-baths produce profuse perspiration, and act in cleansing the skin much as hot-water baths do, only more powerfully. Vapour being a slow conductor, does not act so fast on the body as water. Vapour-baths can be borne hotter than warm-water baths, but their use cannot be continued so long, as vapour interferes with radiation of heat from the body. In such baths a heat of more than 122° is not borne comfortably. The vapour-bath, though falling considerably short in temperature of the air-bath, raises the heat of the blood somewhat more. The great virtue of these baths is in their sweat-producing properties. The average loss of perspiration by the use of a Russian bath has been set down at from ¾ lb. to 3 lbs. In the Russian bath a slight degree of stimulation of the skin is caused by switching it with twigs of birch, and the alternation of depression and excitement of the cold bath is obtained by placing the patient, when in a state of profuse perspiration, under a douche of cold water.

III. **The Simple Hot-Air Bath.**—There are two forms in which the hot-air bath is administered: according as the patient does not or does breathe the heated air. The action of the latter closely resembles that of a vapour-bath, but differs from it in not impeding the respiration, as the latter does by depositing moisture in the bronchial tubes. The lungs, instead of requiring to heat up the inspired air, are subjected to a temperature above their own. Hot-air baths favour the highest degree of perspiration, while the moisture of vapour baths somewhat retards it. If they are very hot, they raise the temperature of the body by several degrees.

As the arrangements for vapour- and hot-air baths are practically the same (except that in the latter it is attempted to exclude all vapour from the *calidarium* or *sudatorium*, the hottest room), the following description of an ordinary hot-air bath, the arrangements of which are closely copied from the Romans, will answer for both.

The patient after unclothing first goes into the *tepidarium*, which has a temperature of 113° to 117°, in which he remains until the perspiration bursts forth, which happens in from twenty-five to forty minutes. He next proceeds to the hottest room or *calidarium* (in which the air is heated by hot-air pipes which are inserted in the walls), of a temperature of 133° to 140°, and remains there until the perspiration runs down his skin, in twelve to eighteen minutes. An attendant then rubs off the perspiration with a woollen glove, and kneads all the muscles for four or five minutes. The patient next betakes himself to the *lavacrum*, where he has water poured over him of the temperature of 81° to 86°; next, the whole body is soaped over, the suds are rubbed off, and the patient goes to the *frigidarium*, where he lays himself on a couch and waits till his skin is completely dry. This may occupy twenty-five to thirty minutes, when the patient dresses and leaves the bath greatly refreshed.

Such is a brief account of these baths, the revived use of which is at present so general. The arrangements vary in detail. For ordinary purposes it is easy to furnish either vapour- or hot-air baths. A great variety of apparatus have been invented for this purpose, which resolve themselves into this, that the patient should lie in bed or on a seat, and have the bed-

clothes or other covering secured from contact with him by the employment of a framework or cradle. Beneath this hot air or vapour is introduced, either directly or indirectly, from a suitable apparatus.

The Sand-Bath.—We may here mention baths of sand, which are a very old remedy. Of late years establishments for supplying them have sprung up in various towns. They are a convenient way of applying dry heat either locally or generally, and are employed in chronic rheumatism. Bags filled with heated sand are useful in hospital and in domestic practice.

Uses.—Both hot-air and vapour-baths are indicated when increased action of the skin is desired. They are used most for the cure of catarrhs, of neuralgic and rheumatic pains, and sciatica. They have also been much employed for reducing obesity. They are useful for general hygienic purposes, but are apt to be given too indiscriminately. Hot-air and vapour-baths are often locally applied with great advantage to a hand, or leg, or arm, in rheumatism or thickened joints.

B. Composite, Medicated, or Artificial Baths.—A great variety of substances have been used in baths at different periods. We must confine ourselves to such as are at present in use and appear to be of some real value, omitting even some that are employed, such as baths of iodine, of iodide of potassium, of iron, of fermented grapes, and of whey.

I. **Composite Liquid Baths.**

1. *The Sea-Water Bath.*—The average amount of salts in sea-water may be set down at 3 per cent.; this may therefore be considered a suitable strength for ordinary salt baths. The quantity commonly used in London hospitals is about 9 lbs. of salt to 30 gallons of water. Some use bay salt, others Tidman's. Owing to the high price of sea-salt in inland continental places, various natural salts, some of them containing a comparatively small amount of chloride of sodium, have been suggested as substitutes; and also, for economy's sake, 22 to 25 gallons have been set down as a minimum amount of water for the bath of an adult. The value of these substitutes can only be determined by observing the degree in which they stimulate the skin. Apparently it does not matter much what particular salt is employed to produce the stimulation. A salt-bath can of course be increased to any strength by the addition of salt, or of the mother lye as it is termed.

The chief uses of salt-water baths are as tonic remedies, especially for the young, when there is any tendency to scrofula or chlorosis; also in convalescence from many diseases.

2. *Alkaline Baths.* — Alkaline baths may be made by adding 6 ounces of crystallised carbonate of soda, or 3 ounces of carbonate of potash, to 25 or 30 gallons of water. Alkaline baths are of use in a great variety of cutaneous affections.

3. *The Corrosive Sublimate Bath.*—Baths of corrosive sublimate are occasionally employed. They are commonly made by adding 3 drachms of corrosive sublimate and 1 drachm of hydrochloric acid to 30 gallons of water. They are employed in some skin-affections, and in secondary syphilis.

4. *Sulphuret of Potassium Bath.*—Baths of sulphuret of potassium are made by dissolving from 4 to 8 ounces of that salt in 25 to 30 gallons of water. A little dilute sulphuric acid is sometimes added. These baths have long been extensively employed in the treatment of cases of skin-disease in which the sulphur that they contain is indicated.

5. *The Nitro-Muriatic Acid Bath.* — The nitric or rather the nitro-muriatic acid bath is made by adding nitro-muriatic acid to water. The ordinary proportion is one ounce of acid to one gallon of water. The discolouring action on clothing makes a full bath of this kind inconvenient for domestic use, and it is best to take it in a bathing establishment. For the ordinary purposes of a foot-bath at home the old directions of Dr. Helenus Scott, who introduced the use of the acid, are sufficient. The vessel must of course be of wood or earthenware. Dr. Scott added four to six ounces of the acid to three gallons of water. This made a rather strong foot-bath. The patient was to keep his feet immersed for thirty minutes: and the bath was to be repeated every other day for two or three weeks. The axillæ, the groin, and the region of the liver were to be sponged with the acid solution. The bath causes slight tingling of the skin and a taste in the mouth, and is believed occasionally to produce salivation. This bath has been used very extensively in India and in England in liver affections. There is difference of opinion as to its value; many have great confidence in it.

6. *The Bran Bath.*—The bran bath is made by boiling four pounds of bran in one gallon of water, straining, and adding the liquor to a quantity of water sufficient for a bath. Such a bath is useful in allaying the irritability of the skin, and also in diminishing the stimulating effect of other baths.

7. *The Fucus Bath.*—This is made by adding a decoction of sea-weed, or the sea-weed chopped up, to an ordinary bath; it will become more or less gelatinous if enough be added. Such baths go popularly by the name of *Ozone baths*; and they contain a certain amount of chloride of sodium and a minute proportion of iodine They are useful in the same cases as sea-baths.

8. *The Mustard Bath.*—An extremely useful stimulating bath is the well-known mustard bath, which is made by adding a handful or two of mustard to the ordinary hot bath. The pediluvium is its most useful form.

9. *Pine Baths.* — Baths of the balsam of pine-leaves may be prepared extempore by making decoctions of the fresh leaflets at certain seasons; but the usual way is to add about one pound of the extract which is prepared from the leaves, and is everywhere for sale—at least in Germany. The extract dissolves in the bath, which is then ready for use; but of late it has been usual to add a small amount of an essence which is also prepared from the leaflets. It floats to the surface of the water, and attaches itself to the person on leaving the bath, and its aroma is grateful. Of course the quantity of the extract to be employed depends on its strength. These baths are at present largely employed. They are slightly stimulant, and are much used in hysterical, rheumatic, and gouty

affections, and also as an adjunct to the internal use of mineral waters.

10. *Baths of Conium, Lavender, &c.*—Aromatic or sedative baths are prepared by adding a decoction of lavender, hyssop, or conium to an ordinary bath.

It is scarcely necessary to add that, as a rule, all composite liquid baths should be of a temperature a little above the tepid; and that their strength, and the time that the patient is to remain in them, must be determined by the special circumstances of the case.

II. **Composite Vapour-Baths.**—Vapour-baths impregnated with *fir balsam* are popular, and are considered to be more powerful in their operation than pine-baths. The vapour which rises in making the decoction of pine leaves is conveyed to a box in which the patient is enclosed.

Aromatic vapour-baths may be given by making the steam of hot water pass through bunches of fresh aromatics (*conium, lavender*, &c.) before reaching the box in which the patient is placed. Such baths may be useful in hysteria.

III. **Composite Air-Baths.**

1. *Sulphurous Acid Bath.*—A valuable mode of applying sulphur in the form of a bath is by using its fumes—in other words, sulphurous acid. The patient is seated on a cane-bottomed chair, and his body is encircled with a cradle, over which oil-cloth is thrown, the head remaining uncovered. Sulphur is placed on a metallic plate, to the lower surface of which the flame of a lamp is applied, when sulphurous acid is disengaged. This bath is less used in cutaneous affections than formerly.

2. *The Mercurial Vapour-Bath.*—Very similar is the mode of applying the fumes of mercury. Under the chair are placed a copper bath containing water, and a metallic plate on which are put from 60 to 180 grains of the bisulphuret or of the grey or red oxide of mercury. Spirit lamps are lighted under the bath and under the plate. The patient thus experiences the effects both of aqueous and of mercurial vapour. At the end of five or ten minutes perspiration commences, which becomes excessive in ten minutes or a quarter of an hour. The lamps are then to be extinguished, and when the patient becomes moderately cool, he is to be rubbed dry. He should then drink some warm liquid and remain quiet for a time. This has often been a favourite mode of treating secondary syphilis with some practitioners. Calomel, in quantities of from 20 to 30 grains, is administered in a similar manner, under the name of the *Calomel Bath*. It may be given locally by a suitable apparatus. JOHN MACPHERSON.

BATHS, Natural. *See* MINERAL WATERS.

BED-SORE. *See* ULCER and ULCERATION.

BELL-SOUND. A peculiar physical sign associated with pneumothorax. *See* PHYSICAL EXAMINATION.

BELL'S PARALYSIS. (Named after Sir Charles Bell.) A synonym for paralysis of the facial nerve. *See* FACIAL PARALYSIS.

BERIBERI.—SYNON.: Barbiers; and numerous other local names.

DEFINITION.—A disease characterised by anæmia, anasarca, degeneration of muscular tissue, effusion into the serous cavities, debility; numbness, pain, and paralysis of the extremities, especially the lower; præcordial anxiety, pain, and dyspnœa; scanty and high-coloured urine; and in some cases drowsiness or sleepiness. Beriberi occurs in a chronic and an acute form; in the latter often proving rapidly fatal from exhaustion, syncope, or the formation of cardiac or pulmonary coagula.

ETYMOLOGY.—The etymology of the word Beriberi is obscure. Herklotts suggests the Hindi word, *Bhèree*—a sheep—from the fancied resemblance of the gait of persons affected to that of sheep. *Soond-bhèree* comes from the words numbness and sheep. *Soond-ke-baiee* signifies numbness and rheumatism. *Bhèr-bheri*, a Hindi word, signifies a sore, a swelling. Mason Good says that Bontius introduced the word Beriberia, and tells us that it is of Oriental origin. Carter suggests *Bhari*, sailor, from *Bahr*, the sea; and *Bhayr*, shortness of breath. As the disease is seen among African and Arab sailors, this is probable. Some think it is derived from a Cingalese word meaning weakness, first applied to a variety of conditions, the result of scorbutic, malarious, rheumatic, and anæmic cachexiæ, on the Malabar Coast.

GEOGRAPHICAL DISTRIBUTION.—Beriberi prevails endemically in Ceylon; and in India, on the Malabar Coast, and in the Northern Circars, between 13° and 20° N. latitude, extending inland from forty to sixty miles. It is known in other parts of India, probably occasionally all over the peninsula; in Burmah and the Malayan peninsula; amongst the crews of ships trading to ports in the Persian Gulf, Red Sea, coast of Africa, Bay of Bengal, Singapore, Siam, and the islands of the Indian Archipelago; and in the Australian seas. On the West Coast and other parts of Africa beriberi also occurs, and is known as the *sleeping sickness*. In Europe *pernicious anæmia* is possibly the same disease. Beriberi is also met with in South America, and probably wherever certain conditions of food, water, soil, climate, and mode of life coexist.

ÆTIOLOGY.—All observation tends to show that beriberi occurs where causes of debility have for some time operated, especially in the climates and localities previously mentioned, such as certain conditions of soil, air, and water; exposure to great alternations of temperature, especially when accompanied by wet, fatigue, mental and physical depression; food deficient in quantity and quality or variety; previous exhausting diseases; malaria, and other undefined atmospheric and telluric influences—all, in fact, that tends to depress the vital energies, impoverish the blood, and starve the nerve-centres. The symptoms, it is said, seldom begin to appear within ten months or a year after first exposure to these causes. Beriberi has been ascribed by Ranking to disease of the kidney, but there is no evidence to prove that it is due to this cause, or indeed to structural changes of any of the viscera. Morehead refers it rather to a scorbutic origin, and in some respects it does resemble

scurvy; it may probably, also, be a consequence of the cachexia that so often results from long residence in a malarious climate, especially when that has been accompanied by exposure, privation, and excessive exhaustion of the vital powers. In such, the most complete anæmia, with debility, may occur, independently of the existence of organic visceral disease, though naturally they will be intensified where such disease is present.

Anatomical Characters.—Serous fluid is effused generally —in the areolar tissue, in the lungs, brain, heart, and abdominal viscera. The cavities are, like the tissues, soaked with watery effusion. The tissues are soft and degenerate. Muscular fibre is fatty, especially that of the heart, which is often enlarged and dilated. The kidneys are enlarged, anæmic, and softened.

Pathology.—The recent discovery by Mr. T. Lewis in India, of the embryo of a nematode worm in the blood of persons suffering from chyluria (*see* Chyluria), lymphorrhœa, and elephantiasis, of which diseases it appears to be to some extent the cause, suggests inquiry whether a similar hæmatozoon may not also be in some way concerned in inducing beriberi. Fonsagrives and Leroy de Mericourt describe beriberi as general dropsy with a rapid course, no albuminuria, and weakness and loss of sensibility in the lower limbs. Dropsy commences as anasarca, and extends to the serous cavities. Though hepatic, splenic, or renal complications may exist, and intensify the severity and hasten the progress of the general symptoms, they are not essential concomitants of the disease, but appear to originate in a spanæmic state of the blood, and to be kept up by its progressive imperfect elaboration. The resulting partial starvation of the cerebro-spinal nerve-centres, and the serous effusion into and amongst them, sufficiently account for the paralysis which, in severe cases, characterises this disease.

Symptoms.—Beriberi presents itself under a *chronic* and an *acute* aspect; rarely, it is said, ever occurring in either form, until after an exposure of some months to the exciting causes. The general symptoms may be said to be those of anæmia and anasarca. Œdema pervades the limbs and body generally, accompanied with numbness, pain, heaviness, and loss of power, amounting in some cases to paralysis. Along with these symptoms there occur præcordial anxiety, dyspnœa, irregularity and palpitation of the heart, pain at the ensiform cartilage, anæmic murmurs, debility, and a small quick pulse, which at the outset may be rather hard and full, accompanied by dryness and heat of skin. The appetite is at first not impaired. Later there is coldness of the extremities; torpor of the bowels; scanty, high-coloured urine, of sp. gr. 1020 to 1040, but no albuminuria as a rule. According to Horton and others, excessive drowsiness and stupor attend some stages of certain cases of the disease; also pale, flabby tongue and blanched mucous membranes; occasionally hæmorrhage from the stomach and bowels; with petechial eruptions; an anxious look; a puffy, swollen, and sometimes livid face; and a peculiar tottering gait. Death results rapidly in some of the acute cases, with symptoms of effusion into the thoracic and abdominal cavities, or within the skull, by exhaustion, syncope, or the formation of coagula, either in the systemic or in the pulmonic circulation. Beriberi frequently assumes a slight and modified form, indicated by anæmia, numbness, and a certain amount of pain in the limbs; an anxious expression; disordered bowels; scanty urine; cold skin; a low, feeble, and irregular pulse; præcordial pain or uneasiness, with palpitation; nervous depression; an unsteady, almost tottering gait; and a puffy face and neck. Dr. Paul says: 'I have met with a numerous class of cases that are not so serious (as the acute) or so often fatal, where the chief symptom complained of was burning of the feet.' Malcolmson describes this remarkable condition in connection with beriberi, to which, he says, it is allied—it is found to affect the soles and calves of the legs, the back, and occasionally the muscles of the legs.' It occurs in recent and slight examples of beriberi, and was first observed in the troops after the first Burmese war—sometimes in men who had not had beriberi; on the whole, Malcolmson thinks it is neither rheumatism nor beriberi, and may accompany or follow other diseases, as an indication of nervous debility.

In the *acute* forms of beriberi the symptoms are very severe and often rapid; and the mortality would indicate it to be second only to cholera in fatality. The chief symptoms are:—Rapid general anæmia and dropsy of the cavities; scanty, almost suppressed urine; constipation; weak, irregular pulse; intense præcordial pain; hurried, irregular, and painful breathing; occasional vomiting—sometimes of blood; swelling of the limbs, with numbness, pain, and paralysis, preceded by a feeble, tottering gait; all the symptoms of pleuritic and pericardial effusion; failing heart; and death either from syncope, or perhaps almost suddenly from embolism—in the most acute cases within a few days. In this acute form the affection is very fatal, but in the milder and more chronic form recovery is frequent. Acute cases often supervene in those who have suffered from the milder disease, or in those who are exhausted and anæmic from other causes.

Treatment.—Attention to diet, suitable clothing, and protection against vicissitudes of temperature, wet, and cold, are the best *preventive* measures. Bad hygiene and exhausting habits of life tend to promote the development of the constitutional condition in which the disease commences.

When beriberi is established these precautions are still necessary, and attention must be paid to the symptoms as they occur. Diuretics and diaphoretics relieve the œdema and dropsical effusions. Tonics and stimulants give vigour to the weakened muscular fibre; while appropriate remedies and diet may improve the condition of the blood.

Acetate of potash, digitalis, and squill, and occasionally calomel, are said to favour the removal of the fluid. It is needless to say that the physiological action of mercury is to be avoided. Salines, hot-air baths, diaphoretics, and turpentine may at various stages be found useful. The object being to remove the fluid and

strengthen muscular fibre, quinine, iron, and other tonics are an important element in the treatment. No remedies, however, will be of much avail unless the patient be placed in favourable hygienic conditions. Malcolmson speaks highly of two remedies—*trēak farook*, and *oleum nigrum*, which are considered to be very effective in the treatment of the disease, especially in relieving the dyspnœa and œdema, which proved very fatal until these drugs were introduced. The composition of the *trēak* is apparently generally unknown—it seems to be diuretic and stimulating, and probably not aperient unless combined with rhubarb, in doses of four to fifteen grains. The *oleum nigrum* is a stimulant and diaphoretic, given thrice daily, and has been found by Indian physicians to be very beneficial in some cases of beriberi. Dr. Aitken says that turpentine is a useful remedy. Ergotin, iron, and belladonna with zinc in the form of pill, accompanied with sea-bathing, were useful in this disease, as seen at Bahia. Nux vomica has often been found serviceable in certain cases, as might be expected, and opium may be needed to allay pain and irritability. Hepatic and splenic complications need their appropriate remedies. Obviously the chief indications are to promote removal of the œdema; to regulate the functions of the abdominal viscera; to increase the action of the skin; and to give tone and vigour to the muscular fibre. By such measures can we alone hope to deal successfully with this profound form of cachexia. JOSEPH FAYRER.

BIARRITZ in France, on the Bay of Biscay. A fashionable sea-side resort. The climate is considered to be bracing. *See* CLIMATE, Treatment of Disease by.

BILE, Disorders of.—Disorders of the bile held a large place in the medicine of antiquity, with the exception of the theories of Van Helmont and Paracelsus; the latter looking upon the bile as the balsam of life, and therefore incapable of begetting disease; the former regarding it as a mere excrementitial fluid, and therefore equally incapable of begetting disease. Disorders of the bile have, nevertheless, held their own quite into our time. It is common enough to hear persons speak of a 'bilious attack,' or 'being troubled with the bile,' expressions the survivals of the humoral pathology. The liver was formerly credited with most of the dyspeptic disorders of the stomach. As Sir Thomas Watson says, it is an organ often blamed most gratuitously and unjustly, but no educated or scientific physician would now think of attributing a gastric catarrh, or constipation, to an 'attack of the bile,' or to a 'sluggish liver.'

Physicians have arranged disorders affecting the bile under three heads—(1) diminished secretion of bile; (2) increased secretion of bile; and (3) secretion of morbid or altered bile. This division may very well be accepted as a convenient basis for the further discussion of biliary disorders, but it is nothing more than an hypothesis. It is likely enough that the bile, in certain diseases, changes its character as regards both its amount and constituent parts: but it cannot be denied that the means by which physicians are able to ascertain these changes can scarcely be said to exist in ordinary cases. A common saying is that the patient must be making plenty of bile because the stools are high in colour. No reasoning can be more fallacious. The colour of the stools may be high if the fæces be quickly swept through the intestinal canal, because there has been no time for the bile-pigment to be absorbed into the blood. Or the fæces may be pale if they lie long in the bowel and the coloured matter absorbed. So that the colour of the stools is no sure sign of the poverty or abundance of the secretion of bile. In cases of pale-coloured fæces purgatives often do good, not because they have any special tendency to increase the flow of bile, but because they hurry the fæces out of the intestine, and thus give no time for the absorption of the bile, which, if it lay long in the bowel, would be absorbed, carried to the liver, and again excreted into the gall-ducts—the vicious circle of Schiff.

Nor is the analysis of the bile found after death in the gall-bladder of much value. Frerichs announced the presence of albumen in the bile in cases of congestion of the liver; but it is now generally thought that this appearance is due solely to a *post-mortem* transudation. Ritter also has described a colourless bile in which all the constituents of bile are present except the pigments. Most of his analyses were made on bile taken from the gall-bladder after death; but if the cystic duct be obstructed for any time, it is well known that the bile contained in the gall-bladder may become colourless without any real secretion of colourless bile having taken place in the first instance. It is impossible to be certain that the changes, which are found in the bile taken from the gall-bladder after death, have taken place during life.

The only source of what may be called knowledge of the disorders of the bile is observation of men or animals in whom biliary fistulæ have been formed either by disease or by art. Unfortunately, the majority of such observations have been physiological or pharmacological; and but few are recorded of the changes which the bile undergoes in disease. Altogether contradictory experiments are recorded of the influence of the nerves and of the diabetic puncture of the fourth ventricle upon the secretion of bile. It is an admirable field for further research, but it will be seen that our present knowledge very closely approaches to complete ignorance.

It is disputed still whether the presence of bile in the stomach puts an end to the process of digestion. By many it is thought that the bile-acids throw down the albumen of the food, and with the albumen the pepsin. It is well known that in some disorders there is an inverted action of the duodenum, and bile is poured into the stomach, as in long-continued vomiting, for instance; thus the dispute has a practical bearing. The best treatment of this state would seem to be by saline purgatives.

Bile may also be taken up into the blood, and when this occurs, jaundice results (*see* JAUNDICE).

J. WICKHAM LEGG.

BILHARZIA. — This name was given by the writer to a genus of flukes discovered by Dr. Bilharz, of Cairo, in the portal system of human

blood-vessels, and the worm was subsequently found by the writer in the portal vein of a monkey. This træmatode hæmatozoon was first described as a *Distoma*, but the species is now more generally known as the *Bilharzia hæmatobia*. It was originally found in the portal system, and Bilharz, Griesinger, Lautner, and others afterwards showed that this parasite also infests the veins of the mesentery, bladder, and other parts, producing a formidable disease which is endemic in Egypt, at the Cape, at Natal, and probably in other parts of the African continent, as well as in the Mauritius. The discovery that the endemic hæmaturia of the Cape of Good Hope is occasioned by the presence of *Bilharzia*, is due to Dr. John Harley, who detected the ova in the urine of a patient who had previously resided in Southern Africa. Dr. Harley's impression that he had to deal with a new species of Bilharzia has not gained general acceptance, but he furnished proof of the wide geographical distribution of this parasite, and he also added largely to our knowledge of its ravages.

Description.—This parasite, unlike nearly all the other known species of fluke, has the sexes separate, the females being comparatively slender worms, resembling filariform nematoids. During copulation the female is lodged in a long slit-like groove, or gynœcophoric canal, with which the abdomen of the male is furnished.

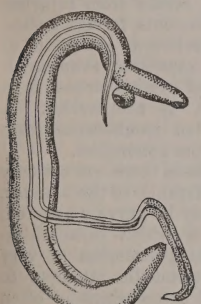

Fig. 2.—*Bilharzia hæmatobia*, male and female sexually combined. Magnified. After Küchenmeister.

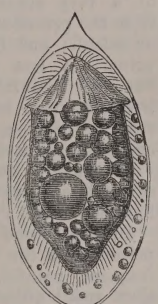

Fig. 3.—Ovum of *Bilharzia hæmatobia* with contained embryo and free sarcode-granules: ×234 diameters. Original.

The eggs, measuring from $\frac{1}{180}''$ to $\frac{1}{160}''$ in length, are peculiar, being either sharply pointed at one end, or furnished with a projecting spine, placed at a little distance from the hinder pole. This spine gives a point of resistance to the egg during the struggles of the embryo to effect its escape. Those who are interested in the organization of the ciliated embryos, and in the remarkable behaviour of the larvæ during their earliest stages of growth, will find the subject fully discussed in the writer's paper 'On the development of *B. hæmatobia*,' together with remarks on the ova of another urinary parasite, occurring in a case of hæmaturia from Natal, *Brit. Med. Journ.*, 1872.

Treatment.—The writer has pointed to the danger of treating cases of Bilharzia as if they were comparable to ordinary helminthiases. It is neither desirable to employ active drugs for the expulsion of the parasite and its eggs from the bladder, nor is it prudent to attempt the employment of vermicides with the view of destroying the worms. As in Trichinosis, so in the Bilharzia disease, it is essential to support the system. Thus tonics, cold bathing, and a highly nourishing diet, combined with the bicarbonate of potash and infusion of buchu, constitute our best resources when dealing with cases of endemic hæmaturia. The pathological facts clearly show that in order to effect a cure we must imitate nature herself as closely as we can. We must seek to erect artificial barriers, and thus check the hæmorrhage as much as possible. For this purpose the writer has found the astringent properties of Arctostaphylos uva ursi eminently serviceable; small quantities of hyoscyamus being usefully combined. Dr. Harley advises 'a persevering use of belladonna and henbane,' under the impression that treatment with these drugs 'will retard the development of the parasite, even if they do not effect its destruction.' The writer entirely disagrees in this view of the case, and he also objects to the employment of medicated injections. He thinks that the employment of diuretics is likewise clearly contra-indicated. Everything that will contribute towards allaying the vesical irritation, is certain to assist the natural process of cure; and, in this view, the administration of buchu-infusion, the enforcing of a liberal diet, and the taking of gentle exercise, will be found amongst the most important curative aids. In bad cases a thorough cure is not likely to be completed until after the lapse of several years. Prophylactically it is essential to remove patients from the localities in which there is every reason to believe they have contracted the disease. In view, also, of preventing infection on the part of others, it is necessary that the water employed for domestic purposes throughout the infected districts, be rendered thoroughly pure by efficient filtration. For further particulars the reader is recommended to consult the general works of Küchenmeister and Leuckart; the writer's introductory treatise on *Entozoa* (p. 197 *et seq.*); Dr. Harley's three separate memoirs (in the *Transactions of the Royal Med. and Chir. Soc.*, 1864, &c.); and also especially the recent memoir by Dr. Sonsino, entitled 'Researches concerning *Bilharzia hæmatobia* in relation to the endemic hæmaturia of Egypt, with a note on a nematoid found in human blood' (*Rend. della R. Accad. delle Scienze, &c.*, 1874). *See* also Hæmatozoa.

T. S. Cobbold.

BILIARY CALCULUS. *See* Gall-stones.

BILIARY FISTULA.—There are two kinds of biliary fistula:—one, in which a communication exists between the gall-bladder and the surface of the body; the other, in which there is a communication between the gall-bladder and other internal organs. Neither kind is common, but the first is less rare than the other.

In the first variety a tumour forms, sometimes in the place of the gall-bladder, at other times near the umbilicus, in the linea alba or to the left of this line, or in the groin. The tumour, if opened spontaneously or by the surgeon, discharges a quantity of pus, bile, and gall-stones. If the cystic duct

be obliterated, no bile need escape. A suppuration of the gall-bladder, caused by the presence of gall-stones, is the common cause of these fistulæ. The prognosis is good. The diagnosis, before the tumour opens, is very difficult. In a case which came under the writer's notice, it was mistaken for an abscess of the liver.

In the second kind of biliary fistula, the gall-bladder may communicate with the duodenum or colon; with an abscess of the liver; with the portal or other abdominal vein, though it must be owned that cases of this kind seem somewhat dubious; or with the urinary bladder, or at least with some part of the urinary tract. Gall-stones are in nearly every case the cause of the fistulous opening. J. WICKHAM LEGG.

BILIOUS.—This term is used with much vagueness, and in popular language is often employed very incorrectly, though the idea is to associate it with conditions in which an excessive formation of bile is supposed to occur. The chief uses of the word are as follows:—In the first place it is employed to designate a peculiar temperament—the *bilious temperament*. Again, individuals are often said to be *bilious* when they present a sallow or more or less yellowish tint of skin, but especially if they are distinctly jaundiced. *Bilious vomiting* and *diarrhœa* signify respectively the discharge of a quantity of bile, mixed with vomited matters or with loose stools. Certain febrile diseases, attended with yellowness of the skin, are sometimes designated *bilious fever*, and under like circumstances pneumonia has been described as *bilious pneumonia*. Lastly, one of the most frequent applications of the term is to certain so-called *bilious attacks* or *biliousness*, which, however, are commonly merely attacks of acute dyspepsia or migraine. The most prominent symptoms of a supposed *bilious attack* are anorexia, furred tongue, a bitter taste, sickness, constipation, and headache, with a feeling of marked depression and general malaise. Such attacks are most effectually prevented by careful regulation of diet, and the avoidance of exposure to cold, fatigue, and undue mental exertion or anxiety; when they come on, abstinence from food is desirable, with rest in the recumbent posture, and perfect quiet. Alterative aperients and saline effervescents may be given, alcoholic stimulants being avoided as far as possible. FREDERICK T. ROBERTS.

BILIOUS TEMPERAMENT. *See* TEMPERAMENT.

BITTER ALMONDS, Poisoning by. *See* PRUSSIC ACID, Poisoning by.

BLACK VOMIT.—Vomited matters may be more or less black in different diseases, but the peculiar *black vomit* is that which occurs in yellow fever (*see* YELLOW FEVER).—The rejected matters are acid in reaction, and a sediment is deposited of coagulated albumen and disintegrated blood-corpuscles. Ammonia is also present. The black colour of the vomit has been attributed by some writers to altered bile, but there can be no doubt that it is due to its admixture with blood which has undergone certain changes.

BLADDER, Diseases of.—The bladder may be the seat of the following morbid conditions:—Inflammation, acute or chronic; Abscess; Neuralgia; Atrophy or Hypertrophy; Mechanical Distension, with chronic engorgement and retention of urine, commonly, but erroneously, termed 'Paralysis'; Sacculation; Displacements, such as hernia in the male, or, very rarely, inversion and protrusion in the female; Tumours or Growths, including fibrous, villous, or vascular growths; Epithelioma and Carcinoma; Tubercular Disease; Ulceration, either simple or malignant; and Vesico-vaginal or Vesico-intestinal fistula. The bladder may also be the subject of true paralysis, partial or complete, as the result of injury to the brain or spinal cord, or following disease of those organs.

Only a brief statement respecting the most important of this class of affections need be presented here, in order to facilitate an acquaintance with their diagnosis, since the treatment of almost all of them belongs to the province of the surgeon, and so far only as it consists of medicinal remedies will the subject be considered.

1. **Acute Inflammation—Acute Cystitis.**—The mucous lining of the bladder is the part affected by inflammation—and although after long and severe attacks some morbid action occurs by extension to the muscular coat, or even to the peritoneal covering, these structures are very rarely affected. An acute inflammation of a very severe kind occurs from injuries; from the presence of instruments, foreign bodies, or calculi; and from unrelieved retention of urine. A less severe, somewhat evanescent, but very painful form of cystitis arises from irritants taken internally, as cantharides. A still less severe, but often troublesome form originates by extension from gonorrhœa.

In the *first* class of cases there are not only severe local symptoms referable to the bladder, but the general system may be gravely affected.

In the *second* class, of which cantharides-poisoning is the type, the phenomena of very frequent, painful, and spasmodic attempts to eject small quantities of urine which is often bloody, occur within a very short time after absorption of the poison. A common blister is said to produce the affection in some persons. In two cases—the only two the writer has seen—it has followed the application of a blister to a surface already partially denuded of the scarf skin. In one of these a blister was applied to a knee which had been frequently painted with tincture of iodine, and was still slightly sore. In three hours after the application the patient was attacked with exceedingly painful efforts to micturate, which were at times intense. The attack lasted six hours, gradually diminishing in force, and leaving no ill-effects behind. In less than twenty-four hours no trace of the symptoms remained.

In the *third* form of cystitis, which is the most common, and of which that arising by extension from gonorrhœa may be taken as the type, the usual symptoms are undue frequency of micturition; a necessity to perform the act immediately the want has declared itself, a condition conveniently expressed by the single word 'urgency;' a desire to pass more, accompanied by pain, when all the urine has been voided; and

some dull aching over the pubes; together with a general febrile state of the system, often very slight, but corresponding for the most part with the degree of local inflammation. The urine itself is cloudy, and deposits some light mucus on standing, but is not otherwise apparently altered. Under the microscope abundance of epithelium is visible, as well as some pus-cells, and if the affection is severe, a few blood-corpuscles are also present. It may be remarked here that the presence of a few pus-cells in the urine, a fact to which so many practitioners attribute considerable importance, by no means necessarily deserves to be so regarded. The very slightest attack either of this or of the preceding form of cystitis is certain to be attended by the formation of some quantity, however small, of fully-developed pus-cells.

Very rarely a *false membrane* may be produced on the surface of the mucous membrane of the bladder, and may be thrown off almost entire, leading to the belief that the inner coat has itself been exfoliated. In women this membrane has been voided per urethram in a condition for examination; in men this cannot occur, because the urethra is too small to admit of it. Now and then examples of the former have been shown at the Pathological Society of London; and one of the latter may be seen, discovered by operation, in the museum of the Royal College of Surgeons of London.

Treatment.—In the first form of cystitis, the removal of the exciting cause, if possible, is the chief indication.

The treatment of the second form should consist of very hot bidets or hip-baths, the former being probably preferable as capable of being used at higher temperatures than the latter; together with large doses of the tincture of henbane, say a drachm, with 10 or 15 drops of liquor opii every two hours while pain is severe; 20 minims of liquor potassæ may be given either simultaneously or alternately, in water or in any bland diluent.

The treatment of a well-marked case of the third class consists in absolute rest in the recumbent posture, mild diet, abstinence from all alcoholic stimuli, gentle laxative action of the bowels, and the administration of small doses of alkali. The writer prefers liquor potassæ to all others, frequently repeated; and this may be combined with henbane, or, if micturition is very frequent and painful, with opium or morphia, or with chlorodyne in small doses. Hot hip-baths or bidets, followed by hot linseed-meal poultices or fomentations, give great relief. The patient may drink freely of decoction of triticum repens, linseed tea, barley water, or similar demulcents. Relief rapidly follows, but care is requisite to avoid relapse, which easily occurs if exercise be taken too soon, if injections for the gonorrhœa be resumed too readily, or if alcoholic stimulants are freely taken.

2. **Chronic Inflammation—Chronic Cystitis.**—Chronic inflammation of the bladder is separated from the acute form by very distinct characters. It is mostly the result of retained urine from stricture or enlarged prostate; but it may arise from the presence of calculi, or of growths in the bladder; from over-distension, or atony of its coats; from paralysis after injury or disease affecting a nervous centre; from disease of neighbouring organs; and sometimes from altered urine: it is also met with in certain affections of the kidney. Sometimes this condition is marked by the presence of a large quantity of viscous mucus, often called 'catarrh'; but more commonly this symptom is absent, and the urine contains merely ordinary mucus or muco-pus, rendering the secretion more or less cloudy and opaque. Perhaps there are some cases in which the inflammation is mainly due to the presence of gout.

Symptoms.—The symptoms of chronic cystitis are increased frequency of micturition and pain, but the latter is by no means necessarily present. The urine is always cloudy, and contains some pus-cells. There is often, but not always, some suprapubic uneasiness. The general health does not suffer unless the affection is prolonged or severe. If important causes, as the presence of stricture, calculus, &c., occasion the chronic cystitis, their specific symptoms will predominate. It is not common to find chronic cystitis as an idiopathic disease, although undoubtedly it occasionally is so; so that the writer has always regarded it as a useful maxim, 'When chronic cystitis is declared to be idiopathic, we may be sure that we have only not yet discovered the real cause.' As a general rule we may be sure that there is inability to empty the bladder, or calculus, stricture, or organic disease of some kind in some part of the urinary tract, when the group of symptoms are present which we denote by the term 'chronic cystitis.' Respecting the well-known glairy mucus, which is deposited so abundantly from the urine in some cases, in elderly people almost invariably, it should be said that it appears only in those whose urine is abnormally retained, through atony of the vesical walls, or in consequence of enlarged prostate, or as the result of sacculation of the bladder, and that medicine has little or no effect upon it.

Treatment.—The regular and habitual use of the catheter, and perhaps also injections into the bladder, form the essential mechanical treatment of chronic cystitis in the cases just mentioned. In the few cases in which chronic cystitis is present, and no organic cause, such as those named above, can be discovered—and also as adjuncts to mechanical treatment when these causes do exist—certain *medicinal* agents are undoubtedly useful: these are buchu, triticum repens, uva ursi, alchemilla arvensis, pareira brava, and the alkalis potash and soda. Buchu is more useful in subacute and recent chronic cystitis than in cases already of long duration. The patient should take not less than ten ounces of the infusion daily. After this, in similar cases, the decoction of triticum repens, made by boiling two to four ounces of the prepared underground stem in a pint or a pint and a half of water, of which six ounces should be taken three or four times in the twenty-four hours, is highly useful. For more chronic cases, where the urine is alkaline and deposits much mucus, and perhaps the triple phosphates also, alchemilla, uva ursi, and pareira brava may be very valuable. The alchemilla is administered in infusion, one ounce of the

herb in one pint of boiling water, of which the dose is four to six ounces three times daily; the others according to the directions of the pharmacopœia. These may be taken alone or combined with potash, which in moderate quantities diminishes the natural acidity of the urine before it enters the bladder; the mucous membrane of which, although accustomed to that condition in health, is perhaps sometimes, when inflamed, irritated by urine of even the ordinary acidity. Whether this be so or not, there is no doubt that alkalis do frequently tranquillise an irritable bladder. They are often given in the form of Vichy water, Vals water, or that of Evian, all strong solutions of soda; but on many grounds the salts of potash are preferable. On the other hand, the mineral acids have been largely administered in cases where the urine is alkaline; although there is no reason to believe that the acid has any direct action through the kidneys, or that it is eliminated by those organs. Alkalinity of the urine in chronic cystitis is almost always due to inability of the bladder to empty itself, and the remedy wanted is not medicine but a catheter, at all events to ascertain whether this be the cause or not. A very small quantity of urine retained in the bladder, say one or two ounces, after every act of micturition, suffices in some cases to maintain an alkaline and otherwise unhealthy state of the secretion: while it is equally true that some patients may habitually, and during long periods of time do fail to empty the bladder, always leaving behind from half a pint to a pint, without losing the acidity of the urine. Of course other signs, and notably great frequency of micturition, are present when such is the case.

3. **Neuralgia.**—It is impossible to deny that the bladder may be, like other parts of the body, subject to symptoms which are described as neuralgia, although the occurrence is an extremely rare one. All the writer can say is, that he has occasionally met with cases in which he has not been able to account, by the existence of any lesion, for pain and frequency in micturition, or for difficulty in performing that act, and where these symptoms have been more or less periodic in their appearance. In such instances he has given quinine, and has occasionally found great relief to follow a few doses; more frequently this has not been the case. But now and then the value of the drug has been so marked as to corroborate a belief in the existence of vesical neuralgia. It must be repeated, however, that examples of such phenomena are extremely rare. The writer has also employed arsenic on the same ground. It is invariably necessary to investigate the general health, as well as the habits and diet of the patient. This, perhaps, may be the place for stating that in all chronic and slight deviations from natural and healthy function in the urinary organs, it is essentially necessary to inquire into the state of the digestive organs, to correct by diet and by medicine when necessary any imperfect action on their part, if possible. Constipation alone, when habitual, may produce considerable irritability of the bladder, so also may the unnecessary use of purgatives. A gentle, easy, and daily action of the bowels, a healthy condition of the primary digestion, the absence of flatulence and distension after food, should be ensured as far as possible in all patients complaining of frequent, difficult, or uneasy micturition; and many such may be completely cured of so-called urinary affections by strict attention to these matters. The writer's strong convictions relative to this fact, grounded on innumerable experiences of its value as an aid in practice, led him nearly twenty years ago to ascertain the great value, for such patients, of Friedrichshall water, now so extensively used; and more than ever he insists on the use of a mild and laxative regimen and diet in their management.

4. Where obstruction to the outflow of urine exists (stricture of the urethra, most forms of enlarged prostate, other tumours, &c.), the muscular walls of the bladder become the seat of **Hypertrophy**, which is a condition of compensation, therefore, and not of disease in or by itself. But such changes in the interlacing muscular fibres existing, **Sacculation** readily occurs, by protrusion of the lining membrane between the bands so produced. On the other hand, most commonly when the prostate is hypertrophied, the bladder becomes gradually distended, its coats become expanded, thinned and weakened, and a certain degree of **Atrophy** takes place. The power of the organ to expel urine is lost or diminished; and micturition being a function of simply mechanical nature, the circumstances of the case demand only a mechanical remedy, viz. the catheter. No medicine can restore power and exercise of function under these circumstances. But atrophy and loss of power may occur from complete or partial loss of nervous influence to the bladder, as in those who are the subjects of paralytic states commencing in the spinal cord or brain. When the paralytic state follows accident causing injury to a nervous centre, the nature of the case is obvious enough. But sometimes the onset and progress of chronic disease in these organs are very slow and insidious; the urinary troubles, as manifested by slowness or difficulty in passing urine, or by urine clouded through inability of the bladder to empty itself, may be the earliest signs of the nervous lesion. On the other hand, impaired gait, and other evidences of central mischief, may be and mostly are earlier phenomena, the derangement in the urinary function appearing at a later stage. For such patients, the habitual use of the catheter is often necessary [always of course when unable to empty the bladder by the natural efforts]; while such constitutional treatment as is indicated by the cerebral or cerebro-spinal lesion present will comprehend that which the bladder demands. It is therefore unnecessary to allude further to that subject in this article. The same remark also applies to those few examples of **Tubercular disease** of the urinary organs, which is always a local expression of a general constitutional state sufficiently considered under its proper head in this work. All other treatment of this malady is local and surgical.

5. Relative to **Tumours**, the varieties of which have already been enumerated, no medical treatment other than that of chronic cystitis is to be thought of.

With almost all affections of the bladder, simple or malignant, ulcerative or associated with fistula, cystitis to some extent and in some form co-exists. It is this which gives rise to the presence of an undue quantity of mucus in the urine; it is often the source of pus, sometimes of blood in small quantity. Thus in all the above-mentioned diseases, some degree of cystitis appears sooner or later. HENRY THOMPSON.

BLADDER-WORMS.—Entozoa having the character of cysts or vesicles, and being at the same time more or less transparent. This general term embraces a variety of parasitic forms, such as *Echinococci*, *Cœnuri*, and *Cysticerci*, all of which are the larvæ of different species of tapeworm. Practically, it is important to know the origin of every kind of human bladder-worm, since the adoption of appropriate hygienic measures may prevent infection by each of the various species. *See* ECHINOCOCCUS, CYSTICERCUS, HYDATIDS, MEASLE, TÆNIA, and TAPEWORM. T. S. COBBOLD.

BLAIN.—A blister, as in the case of chilblain. According to Mason Good, blains are 'orbicular elevations of the cuticle, containing a watery fluid.'

BLEB.—A large vesicle or bulla, containing for the most part a serous fluid, as in pemphigus, erysipelas, or burns and scalds. *See* BLISTER.

BLENORRHŒA, BLENORRHAGIA (*βλέννα*, phlegm, and *ῥέω*, I flow; *βλέννα*, phlegm, and *ῥήγνῦμι*, I burst out). These terms are most correctly used to express excessive flow of mucus from any mucous surface. By means of an affix, the locality or nature of the discharge is expressed: *e.g.*, *blenorrhœa oculi*, *nasalis*, *urethralis*. More commonly, however, and less accurately, blenorrhœa is employed as synonymous with gonorrhœa in the male or female.

BLEPHARITIS (*βλέφαρον*, an eyelid). Inflammation of the eyelids. *See* EYE and its Appendages, Diseases of.

BLEPHAROSPASM (*βλέφαρον*, an eyelid, and *σπάσμα*, a spasm). Spasmodic movement or contraction of the eyelids. *See* EYE and its Appendages, Diseases of.

BLINDNESS.—Loss of sight. *See* AMAUROSIS, and VISION, Disorders of.

BLISTER.—SYNON.: Bleb; Bulla; Fr. *Bulle*; Ger. *Blase*.

DEFINITION.—A vesicle of the skin, caused by the separation of the horny cuticle from the rete mucosum by the transudation of serous lymph beneath the former.

ÆTIOLOGY.—Blisters may be idiopathic, as in pemphigus; or symptomatic, as in erysipelas. They are met with under the influence of any cause which depresses the vitality of the integument, as in some forms of prurigo, in chilblain, and in carbuncle; in scalds and burns; and as an effect of powerful irritants, such as cantharides or the aniline salts.

DESCRIPTION.—A blister ranges in size from that of a pea to a turkey's egg; it is more or less convex according to the amount of exudation; and conforms in colour with that of its contents, being sometimes yellow or amber-coloured and transparent, like serum, sometimes opalescent from the presence of pus, and sometimes red or purple from admixture with blood. The fluid of a blister, generally limpid and free, is sometimes held in the meshes of a delicate network, resulting from the stretching of the connecting cells of the rete mucosum and horny epidermis. This is peculiarly the case in blisters developed under the influence of acute inflammation, and especially in Dermatitis anilina. Blisters may be dispersed, or aggregated, or even single, as in Pemphigus or Pompholyx solitarius.

TREATMENT.—Blisters are essentially asthenic in their nature, and call for corroborant therapeutical treatment. Locally they should be punctured so as to admit of the gradual escape of their contents, and then dusted over with some absorbent powder, such as oxide of zinc, fuller's earth, or cinchona. ERASMUS WILSON.

BLISTERING.—A therapeutic measure which consists in the artificial production of blisters on the skin. *See* COUNTER-IRRITATION.

BLOOD, Abstraction of.—SYNON.: Bleeding; Blood-letting. Fr. *La Saignée*; Ger. *Der Aderlass*. — DEFINITION. — The withdrawal of blood from the body, either (*a*) from the general circulation, by arteriotomy or phlebotomy; or (*b*) locally, by leeches, scarifications, or wet-cupping.

It is to the first two of these methods of abstracting blood that the term 'bleeding,' or 'blood-letting,' has by common usage been restricted.

The topical abstraction of blood by means of leeches, scarifications, and cupping, though often valuable, is of secondary importance. The present article will, therefore, chiefly be devoted to *general bleeding*.

General Bleeding.—This art, practised for centuries more or less universally, has of late years in this country fallen into disfavour. Much discussion has been raised as to the grounds for so great a difference. It has been attributed—(1) to the type of disease having undergone a change; (2) to mere fashion or caprice; (3) to a better knowledge of the nature of disease, teaching us that its processes were of a lowering or depressing character, which were to be overcome, not by the abstraction of blood, but rather by the use of stimulants and support. It is highly probable that several causes have contributed to the undoubted change which has taken place. The year 1830 and subsequent years were marked by the epidemic visitation of cholera and of influenza. These diseases were characterised by extreme depression. If antiphlogistic measures were adopted, they proved failures, and taught the physician that blood-letting was not the universal panacea it was supposed to be. By degrees it ceased to be practised as it used to be. A new generation which knew not the past has sprung up; and, as in all reactionary movements, the practice has become at length as limited as it formerly was universal. It is almost certain that in either extreme there is an evil, and that we may have recourse in certain cases to abstraction of blood with some degree of that success which formerly led to its extensive use, if not its abuse. It will be well to consider the subject at some little length, and under the following heads:—

1. The effect of moderate losses of blood on the healthy economy.

2. The value of bleeding as a remedy in disease, together with the indications for its employment in various affections.

3. The method of performing the operations of opening an artery—arteriotomy; and opening a vein—phlebotomy.

1. Effects.—We have first, then, to consider the effect of moderate losses of blood upon the healthy economy. Upon this point we have abundant evidence, for the custom of regularly bleeding healthy people had reached such a point during the earlier half of this century that in country districts it became a practice for adults to be bled as regularly as they went to market. No better testimony regarding the effects of this practice could be adduced than that of Sir James Paget, who, when referring to these customary venesections, says: 'I can regard those as a series of venesections fairly performed for the determination of what is the influence of the removal of blood up to the point of syncope upon a comparatively healthy person. I think I can say surely that not one of these persons suffered harm.' To this might be added other and abundant testimony to the harmlessness of venesection on the healthy economy.

2. Indications and Uses.—Concluding, then, that the abstraction of a limited quantity of blood has no deleterious effect upon the healthy organism, we will next set forth the general indications for the use of bleeding in disease, and briefly refer to the various affections in which it may most suitably be employed.

Broadly stated it may be said that bleeding is indicated when there is evidence of marked over-distension either of the arterial or of the venous system. In either case the result will be cardiac distension—in the former case of the left, and in the latter of the right chambers of the heart. In such conditions general bleeding restores the lost equilibrium of the vascular system, and relieves the heart and the other parts concerned in the circulation of the blood.

The arterial system may be in a state of augmented tension from two causes: (1) contraction of the arteries (the smaller vessels) themselves with a diminished amount of blood in the arterial system; and (2) engorgement or distension of the arteries from spasm of the arterioles: both may be regarded as vaso-constrictive neuroses. In the first case there may be engorgement of the venous system and embarrassment of the right heart, calling for abstraction of blood by *venesection*; or visceral fluxion, the skin being pale: and in the second, relative emptiness of the veins with overfulness of the larger arteries, calling for blood-letting by *arteriotomy*.

In the former condition there would be, in bed-side language, a *small* hard or wiry pulse, and in the latter a *full* and hard or bounding pulse. In the former the surface of the body may present one of the two following conditions: either the skin is injected and, perhaps, dusky, and this appears to be the case ordinarily; or it is pale and cool, the blood having receded inwards, chiefly to the abdominal viscera. The second condition obtains and is well seen in cases of uræmic asthma, when the arterial system is turgid almost to bursting, while the veins are comparatively empty. 'Hardness' of the pulse is usually said to be an indication for bleeding, and in certain associations it is so; but it is necessary to discriminate carefully between the 'hardness' due to 'tension' of the sound artery arising from (*a*) excessive contraction (the small, hard, wiry pulse), and (*b*) overfulness (the full, bounding pulse) on the one hand; and that due to arterial degeneration with more or less hard deposit in the walls of the vessels, on the other. In doubtful cases inquiry should be made into the state of the brachial artery at the bend of the elbow. This can readily be done by flexing the limb, when, if calcareous degeneration have taken place, the vessel will be thrown into serpentine folds, visible, except in fat people, to the eye, and cord-like and rigid to the touch. The temporal artery is a less safe guide, but neither it nor an arcus senilis should be overlooked in this connexion. A visible and tortuous pulse in a young person may indicate aortic regurgitant disease: the age of the patient must therefore be taken into consideration.

Dilatation of the arterioles would permit of the rapid passage of arterial blood into the veins: under such circumstances, therefore, we should expect the blood issuing from a cut vein to present a more florid appearance than under ordinary conditions. Bleeding here should be undertaken with considerable circumspection, and not be pushed very far, for collapse out of proportion to the amount of blood abstracted might ensue. On the other hand, when there is spasm of the arterioles, and the abstraction of blood is deemed advisable, it would be well to resort to arteriotomy rather than venesection. The best guide here would be the sphygmograph, but, as few persons are yet accustomed to use it, the full, hard, bounding pulse must be relied on when found in association with corroborative symptoms.

Whatever leads to over-engorgement of either side of the heart may render bleeding necessary. If the left side of the heart be over-full, arteriotomy is indicated; if the right, venesection. The object of the withdrawal of blood from the general circulation is the direct relief of the overburdened heart. Whether the right or left chambers be taxed the immediate effect is the same; they are over-distended, and cannot get a grip upon their swollen currents. It is with the embarrassed heart as with other hollow muscular organs—the bladder and uterus. Over-distension paralyses them by removing the 'points d'appui' essential for the initiation of muscular contraction; the energy may be there, but it cannot be exercised. It is obvious that the amount of blood which it is necessary to withdraw, in order to free the embarrassed organ, must vary considerably in different cases. But it may be safely laid down as a rule that it need rarely exceed a few ounces. Excess in this respect is the evil which formerly existed.

On this subject we may refer to the eminently practical remarks of Sir Thomas Watson, who says: 'I hold it, then, to be certain, that for some special morbid conditions, which inflammation may or may not accompany, general blood-letting, and especially venesection, is a potent and life-

preserving remedy; that there are many exigencies for which it is not only safe to employ, but unsafe and unpardonable to withhold it.'

He also gives the following judicious advice:—

'Always it is necessary to consider the age, the sex, the general temperament and condition of the sick person, when we are turning over in our minds the expediency of abstracting blood. The very young, the old, the feeble, the cachectic, do not bear well the loss of much blood. This consideration is not to deter you from bleeding such persons topically when they are attacked by dangerous inflammation, but it especially enforces, in regard to them, the golden rule that no more blood should be abstracted than seems absolutely requisite to control the disease.'

The following are some of the affections under which blood-letting would seem to be more or less indicated:—

Pneumonia.—Blood-letting in pneumonia, as in many other inflammations, is most useful in the early stages. It is indicated in healthy patients suffering from uncomplicated acute sthenic pneumonia, if they happen to be seen early enough. It relieves pain, abates fever, and if it does not arrest the disease, it certainly appears to lessen its duration. It may also be called for when there is severe pain and evidence of cardiac embarrassment. It did good, and will still do good, in cases of pneumonia, attended by embarrassment of the circulation, and that in truth is the indication for bleeding in this disease.

Apoplexy.—The same may be said with reference to cerebral apoplexy. The old belief in the importance of 'letting blood' in cases of apoplexy was, if possible, stronger than in cases of pneumonia. But here again more accurate clinical and more extended pathological knowledge have taught us to look upon 'apoplexy' very differently to our forefathers. Recognising the escape of blood from the bursting of a brittle artery as a common cause of 'apoplectic fits,' we see the futility of venesection when the 'stroke' or 'fit' is due to a lesion of this kind. Nor will bleeding unstop an artery when it is plugged by an embolus, or carry nutriment to the region thus bereft of vital fluid. On the other hand we have learnt to recognise the value of bleeding in another class of cases of so-called 'apoplexy'—those which are unaccompanied by effusion of blood or lesion of the nervous tissue, but depend on rapidly occurring compression of the nervous centres from sudden or unequal increase in the volume of any portion of the cranial contents; or in certain eclamptic cases from the circulation of blood poisoned by uneliminated urinary excreta. In cases of this description, when the right heart and venous system are engorged, phlebotomy acts well; the stertor will cease, the purple face resumes its natural hue, the clouded intelligence becomes clear, and the impending danger is for the time averted. This has not cured the patient, however, it has only 'obviated the tendency to death:' it has saved the patient's life, though he may ultimately die of the disease which afflicts him. Where we meet with evidence of cerebral congestion accompanied by fulness of the veins, a dusky countenance, and a *slow* full pulse, bleeding may most usefully be resorted to. In a word, although bleeding will not remove the effused blood in cases of cerebral hæmorrhage, it may sometimes be usefully employed to prevent further escape, when the heart is acting too forcibly; but it is altogether forbidden when that organ is enfeebled. The pulse at both wrists should be attentively examined before bleeding, in cases of cerebral hæmorrhage, for as a rule it is larger on the paralysed than on the sound side.

Eclampsia. — Indiscriminate bleeding in eclamptic seizures would be a grievous error. It would not relieve, but rather would probably intensify, convulsions of reflex origin, as in certain cases of puerperal convulsions. On the other hand, cases of puerperal convulsions accompanied by great turgescence of the vascular system, whether venous, (as is commonly the case) or arterial, would be immensely benefited by the withdrawal of blood from the general current, either by venesection or by arteriotomy, according to the indication. This treatment may serve to stop the convulsions, and though that may be far from curing the disease, it may, nevertheless, be of the utmost value, for in the first place the fits themselves may kill by their violence or frequent repetition; whilst, secondly, time may be gained for the employment of other measures calculated to relieve the oppressed system, as, for example, purging by hydragogue cathartics, vapour baths, cupping the loins, &c. This gain may be immense; for bleeding may avert impending dissolution. Moreover, permanent good may ensue, inasmuch as bleeding reduces temperature, and in the eclampsia of pregnancy the temperature is usually high. In this it contrasts with pure uræmic convulsions, in which there is lowering of temperature.

Venous Engorgement.—Engorgement of the venous system arising from chronic disease, *e.g.* pulmonary emphysema or heart-disease, does not call for bleeding, unless the condition be acutely intensified by some intercurrent mischief, such as acute bronchitis; for, as the derangement is slowly produced, the organs and structures involved learn to accommodate themselves more or less to the altered conditions. It is only when vascular engorgement suddenly occurs in apparently healthy subjects, or, as stated above, there is acute intensification of a chronic condition, that bleeding is required. Thus, in cases where mediastinal tumours impede the return of blood from the head and upper portion of the body, the condition is ordinarily of such comparatively slow production, that bleeding is seldom urgently called for; and, moreover, it would be of but small service, for the obstruction is irremediable

The lividity of the face which accompanies all fits should not be confounded with the duskiness due to engorgement of the venous system generally.

Uræmia.—In pure uræmia bleeding is useful; the kidneys being especially in default. For venesection answers a double purpose, by not only relieving the engorged right heart and venous system, but removing from the body a certain amount of poisoned blood—blood that is charged with urinary excreta. Doubtless, it does

good in both ways, but the former is, *quoad* the fits, the more important because more immediate mode of its action. The second effect, that of ridding the body of damaged blood, is obviously available to us when we have to deal with uræmia, occurring in the non-pregnant; and when coma is deepening, the heart labouring, and the vascular system turgid, no remedy is so swift and sure as the lancet.

Plethora.—Blood-letting may be called for in cases of general plethora, whether sthenic or asthenic. In the former condition the vascular system generally seems to be overfull, though the excess is most marked in the arterial system. Arteriotomy, however, is seldom called for, though it might at first sight seem indicated, since venesection usually answers every purpose.

In asthenic plethora, on the other hand, the venous system only is overfilled; the right side of the heart is distended and its action is laboured. Here venesection is sometimes called for, but it should be carefully employed. It is seldom necessary to withdraw more than 6 to 10 ounces of blood, and often a smaller quantity suffices.

Peritonitis.—The relief obtained by bleeding in acute peritonitis rendered venesection a famous remedy in this affection in former times. And there can be no doubt about its efficacy in relieving the pain of peritonitis, as of inflammation of other serous membranes. It may be used when the patient is young and strong, and in that stage of the disease which is accompanied by a small, hard, and wiry pulse—the pulse of a contracted artery, of augmented tension from contraction, not from overfulness. It is worse than useless in the later stages of the disease, when adynamia has set in. But valuable as bleeding may be in certain cases of peritonitis, it rarely happens that it is admissible, for in the great majority of cases inflammation of the peritoneum is secondary to other diseases, and notably to disease of the kidneys. Where peritonitis arises after delivery it is commonly of septicæmic origin, and it is seldom indeed that bleeding is of any avail under these conditions. So that, practically, bleeding is not a remedy which we can often employ in peritonitis. A very high temperature cannot alone be held to be indicative of its use, for it so happens that such pyrexia is as a rule present only in septicæmic cases. Some cases of peritonitis, even fatal ones, run their course without any marked elevation of temperature: or indeed without showing any definite symptoms. Probably venesection is most serviceable in traumatic peritonitis, or it may be, when the inflammation is localised, though in that case leeches are more suitable.

Pleurisy.—When pleurisy attacks a young and robust patient, and is accompanied by severe pain, great relief follows blood-letting. The blood should be taken from a vein, and *pleno rivo*. But when, as so often happens, pleurisy is, like peritonitis, secondary to damaged blood-conditions—*e.g.* Bright's disease—bleeding is often inadmissible. When, as in pleuro-pneumonic cases, pleurisy complicates pneumonia, bleeding may possibly be called for, if there be great pain and oppression of the chest; but it should be most circumspectly used. Local blood-letting is much to be preferred if bleeding be thought necessary; for general bleeding is usually incompatible with the strength of the patient.

Uræmic Asthma.—In the affection known as uræmic asthma, in which there is spasm of the systemic arterioles, with intense turgidity of the arterial system and engorgement of the left heart, bleeding, in the form of arteriotomy, appears to be clearly indicated.

Spasmodic Bronchial Asthma.—Pure asthma is doubtless often a nervous malady, and bleeding is not a remedy which should ordinarily be employed for its relief. It is only admissible when spasm of the pulmonary vessels, or obstruction to the flow of blood through them from bronchiole-spasm, leads to rapid engorgement of the right heart and venous system. This is the exact converse of uræmic asthma: but the effect in both is impediment to the aëration of the blood. Here the abstraction of a few ounces of blood from a vein may give immense and very prompt relief.

Emphysema.—It is not so, however, in the so-called 'asthmatic attacks,' which chronically emphysematous people are so prone to. Here venesection may be imperatively demanded when an acute attack of bronchitis has, by adding to the already difficult passage of blood through the lungs, excited rapid engorgement of the dilated heart and previously turgid venous system.

Puerperal Diseases.—Formerly bleeding was much employed in midwifery practice, and especially in inflammatory affections after delivery. We now recognise that for the most part post-partum affections arise from septic mischief and are of an adynamic type. It is but seldom that we are called upon to bleed in these cases. Nevertheless, now and again, venesection may be called for.

Disorders of Menstruation.—Bleeding is a most valuable remedy in certain menstrual disorders, and especially in the plethora of women at the change of life. Many women suffer distressingly from general vascular disturbance at this period. The flushings, headaches, giddiness, feeling of oppression and other vaso-motor phenomena which they suffer from in association with the cessation of the catamenial flow, are immensely relieved by an occasional venesection. No other measure will so quickly and so effectually relieve these symptoms. Some robust, plethoric, amenorrhœic young women require periodical bleeding. The writer has known the abstraction of a few ounces of blood to be speedily followed by the occurrence of the menses, in cases of what may be called congestive amenorrhœa of many months' or even years' duration. It may be well to state in this connexion that in certain pulmonary, intracranial, and other visceral lesions, danger may arise from the augmented arterial tension which for a few days precedes the flow, and that the abstraction of blood may avert hæmorrhage into the damaged organs.

After Operations.—Bleeding is less frequently called for in surgical than in medical practice. It is indicated mainly in the after-treatment of cases which present engorgement of the right heart and venous system, as in some cases of ovariotomy and other operations involving the ab-

dominal or thoracic cavities. A turgid venous system, with a small hard pulse, and a labouring heart—a condition which is often associated with scantiness, amounting almost to suppression, of urine—indicates blood-letting after operations of the kind above referred to.

Shock.—In certain cases of shock the abstraction of a limited amount of blood may be required. This point will be found discussed elsewhere (*see* SHOCK).

Fever.—That bleeding will lower the temperature of fevered patients has been known from the earliest times. It is, however, not a remedy to be resorted to for that purpose alone, for, as the most pronounced hyperpyrexia occurs chiefly in association with conditions leading to great depression, blood-letting is under such circumstances as useless as it is dangerous.

Insolation.—There are few disorders in which blood-letting is more successful, when rightly employed, than in sunstroke. It is seldom necessary to take more than a few ounces of blood; and excess should be particularly guarded against, for fear of subsequent collapse. The insensible patient with turgid veins, a tight pulse, and labouring heart, will gain immense and prompt relief from venesection. The extreme pulmonary congestion and over-distension of the right heart so often found *post mortem* might probably be prevented by the timely abstraction of a little blood from the venous system. Bleeding is not to be thought of in the syncopal form.

3. METHODS OF BLEEDING.—The following are the methods of performing the operations of arteriotomy and phlebotomy.

Arteriotomy.—This operation is best performed on the temporal artery. The vessel should be partially cut through by a simple transverse incision, and when a sufficient quantity of blood has been obtained it may then be completely severed, so that, retraction of both ends taking place, the hæmorrhage may be arrested. A compress of dry lint should then be applied, and a tight roller-bandage applied over it.

Venesection.—The median basilic vein is the one usually selected for the operation on account of its being most readily found. The brachial artery lies immediately beneath it, and care must be taken to avoid wounding the latter vessel. The median cephalic vein is preferable, but is not so easily found. A vein on the dorsum of the foot or other part of the body may be chosen, but, as a rule, it is not desirable to open the jugular vein, especially on account of the danger of the entrance of air, and other risks.

The steps in the operation on the arm are as follows:—First, the limb is to be firmly bound above the elbow by a broad tape or fillet. This should be applied with sufficient tightness to compress, and prevent the return of blood by, the veins, but not so as to intercept the current in the artery, and extinguish the pulse. An oblique slit is to be made in the vessel by means of a small lancet, care being taken not to cut too deeply. The spirting blood should be caught in a vessel and measured.

When sufficient blood has been withdrawn, the operator should firmly place a thumb or a finger on the aperture, and then, on removing compression, place upon the wound a dossil of dry lint, antiseptic dressing, styptic-colloid, or such-like, over which a roller-bandage should be twined a few times like a figure of 8, the cross being over the wound.

Local bleeding.—The object of local bleeding is the relief of congested vessels, and especially those of inflamed parts. Arteries convey more blood to, and veins convey more away from, inflamed parts; so that local bleeding may give great relief and initiate resolution, since absorption does not fully commence until inflammation has ceased.

METHODS OF LOCAL BLEEDING.—Blood may be abstracted topically by leeches, by scarifications, or by wet-cupping.

1. *Leeching.* An average leech will abstract nearly half an ounce of blood. Leeches are extremely useful in a great variety of affections, since a pretty definite amount of blood can be withdrawn from the affected or adjacent parts, or from more distant parts, through intimacy of the vascular connexion, as in diseases of the eye and ear, and in hepatic diseases, accompanied by obstruction to the flow of blood through the portal system, when the application of leeches to the anus is most valuable.

Care should be taken not to apply leeches to parts over which sufficient compression cannot be made to control the bleeding, should any difficulty arise in arresting it otherwise. Thus, leeches should not be applied over the trachea, especially in children, in whom the error of applying them over the episternal notch is sometimes made. For the same reason the fontanelles should be avoided.

The skin of the part where leeches are to be applied should first be washed, and when they do not bite readily the part may be wetted by a little milk or sugar and milk. A slight prick of a needle, sufficient to draw a speck of blood, will often cause them to bite when refractory.

Should the bleeding continue too long after the leeches fall off, pressure or styptics may be applied. If it is desired to encourage bleeding, fomentations of hot water or linseed poultice are serviceable.

In applying leeches to the cervix uteri the precaution of closing the os by a plug of wool, should not be neglected. When applied within the mouth a leech-glass should be used.

2. *Scarifying.*—Scarifications consist in small cuts of a depth not exceeding the eighth of an inch or less into the tissue whence it is desired to take blood. This mode of topical bleeding is mainly applied to the cervix uteri, to the tongue in acute glossitis, and to the palpebral conjunctiva in certain kinds of conjunctivitis; in the last case only slight incisions are permissible. Deeper punctures are made by some practitioners into the tissue of the cervix uteri, but these are punctures and not mere scarifications.

3. *Cupping.*—Cupping and the use of the scarificator constituting wet-cupping is an important method of topical blood-abstraction; and as a considerable amount of blood can thus be withdrawn, the general circulation may thereby be

affected. It is ordinarily employed, however, for its local effects.

The method of its performance is as follows:—Cupping-glasses being first put on for a brief time, as for dry-cupping (*see* CUPPING—*Dry-Cupping*), the operator applies to the part selected a spring scarificator so adjusted as to cut only to the required depth—about an eighth of an inch or less. The cupping-glasses are then re-applied, and the desired number of ounces of blood abstracted. If the glasses be too tightly attached the blood will not flow readily, and unnecessary pain may be caused. After their removal adhesive plaster or dry lint and a bandage should be applied to the part.

Cupping over the loins is extremely useful in renal ischæmia; on the temple or behind the ears in certain cerebral disorders; down the spinal column in inflammation of the spinal cord or meninges; and on the chest in certain pulmonary affections. ALFRED WILTSHIRE.

BLOOD-DISEASE.—The term *blood-disease* was used by the humoral pathologists as synonymous with *dyscrasis* or *anomalous crasis of the blood*, and expressed the idea that the blood was the seat 'almost without exception' of all general diseases. And, further, since purely local disease was considered to be exceptional, the vast majority of diseases were referred to dyscrases, and were classed under the head of blood-diseases.

The condition of the blood was considered by the humoralists to depend upon the *crasis*, that is the mixture, of its constituents; and prominent among its constituents were reckoned the *blastemata*, or germinal substances of the different tissues, which exuded through the capillary walls in the process of nutrition. When the blood-crasis was disordered or diseased, a dyscrasis was said to exist, and dyscrases were held to be in the majority of cases primary; though it was allowed that local anomalies of nutrition might and did occasionally occur, and give rise to secondary dyscrases. A blood-disease or dyscrasis being established, all morbid changes throughout the body were believed to be but local manifestations of the same. For the purpose, therefore, of a rational classification of diseases, a previous classification had to be made of the dyscrases. The principal blood-crases were said to be:—

1. The *fibrin*-crasis; including the *simple* fibrin-crasis, the *croupous* crasis, and the *tubercle*-crasis as varieties. The local expression of the fibrin crases was inflammation in some form.

2. The *venous* crasis, in which fibrin was deficient. This included a vast number of special crases, lying at the foundation of the most diverse diseases—*e.g.*, plethora, heart-disease, acute exanthemata, rickets, albuminous urine, cholera, acute tuberculosis, lardaceous disease, cancer, acute convulsive diseases, metallic poisoning, &c.

3. The *serous* crasis; associated with anæmia.

4. The *putrid* or *septic* crasis.

5. Anomalous crases; such as those of syphilis, gout, &c.

The theory of dyscrases may be said to have declined since the appearance of Virchow's *Cellular Pathology*. Virchow showed that the blood is in every relation a dependent and not an independent fluid, and that the sources from which it is sustained and restored, and the exciting causes of the changes that it may suffer, lie without it and not within it. Substances may enter the blood and affect the corpuscles injuriously; the blood may act as a medium in conveying to the organs noxious substances that have reached it from various sources; or its elements may be imperfectly restored. But never is any affection of the blood itself—any 'dyscrasis'—permanent, unless new influences arise and act upon the blood through some channel or through some organ.

At the present time, while it cannot be said that humoralism is professed by many pathologists, the notion of blood-disease, as generally entertained thirty years ago, still clings to the nomenclature, and pervades some of our pathological doctrines. Diseases that affect the whole economy—syphilis, tuberculosis, gout, and cancer—are frequently described as 'constitutional,' or 'blood-diseases,' and that whether their general manifestations are secondary to local disease, as in syphilis and cancer, or are referable to inheritance. While the *morbid conditions* of the blood are real and numerous, 'blood-diseases,' so called, are but abstractions, and, as such, a fruitful source of confusion and useless discussion. It is desirable that the term *blood-disease* should be abandoned, and that the expression *morbid conditions of the blood* should be applied to the pathological states of the vital fluid, which can be distinctly demonstrated by physical, chemical, or histological examination.

J. MITCHELL BRUCE.

BLOOD, Morbid Conditions of.—The characters, composition, and functions of the blood in health are sufficiently familiar, and do not require to be described here. But certain facts connected with the physiology of this fluid have a special bearing upon its pathology, and must be briefly considered before its morbid states can be profitably discussed.

A. PHYSIOLOGY OF THE BLOOD.—The *Red Corpuscles* of the blood consist of two portions—a colourless, sponge-like matrix; and a coloured substance of complex composition, which occupies the interstices of the former and accurately fills them. The matrix is regarded as possessing chiefly physical properties; while its contents constitute the active part of the corpuscle, and consist of hæmoglobin. The *source* of the red corpuscles is of the greatest pathological importance. In the embryo the blood and blood-vessels are developed from the same elements, and thus the two structures in their physiological aspect are essentially inseparable. In fully-developed blood the source of the red corpuscle is obscure: but there can be no reasonable doubt that it originates in the colourless corpuscle, and more remotely in the lymphatic glands, the spleen, and the medulla of bones; and that light is of the greatest importance in the formation of hæmoglobin. With respect to the properties and *function* of the red corpuscle, it is to be noted that the ultimate elements of hæmoglobin are carbon, nitrogen, hydrogen, oxygen, sulphur, and iron,

—the last of these probably being the cause of its red colour. Hæmoglobin is soluble in water, forming a lake liquid from which fine crystals may be obtained, and which may be variously decomposed, giving rise to other 'blood crystals.' Most important of all its properties, hæmoglobin combines with certain gases to form definite chemical compounds;—with O to form oxyhæmoglobin; with CO to form carbonic-oxide-hæmoglobin; and with N^2O to form nitrous-oxide-hæmoglobin. These compounds, and especially the oxyhæmoglobin, are exceedingly unstable, being reduced even under very feeble influences to hæmoglobin and their other constituents respectively. Alternate oxidation of hæmoglobin and deoxidation of oxyhæmoglobin are constantly going on within the red corpuscles of the circulating blood; and the two changes, occurring in the pulmonary and systemic capillaries respectively, constitute the first great function of the blood—its oxygenating or respiratory function. The volume of oxygen in arterial blood is 16·9 per cent., and in venous blood 5·96 per cent. It must be clearly understood that disorders connected with the red corpuscles or respiratory elements of the body, whether in amount, composition, or circulation, directly affect the oxidation-processes only. Besides its origin and its function, there is a third relation of the red corpuscle to the organism—namely that of its *products*. These are eliminated by the ordinary channels; the salts, which are chiefly salts of potash, being excreted by the kidneys, and the coloured material furnishing the pigments of the bile and urine.

The *White or Colourless Corpuscles* of the blood, also called *Leucocytes*, are chiefly derived from the corpuscles of the lymph, and the cells of the lymphatic glands and allied organs, which they closely resemble. By escaping through the walls of the blood-vessels, they become identical with the wandering-cells of tissues and with pus-corpuscles,—from which they are indistinguishable except by locality. Such is the origin, and such are some of the functions of the white corpuscle, and its occasional development into the red corpuscle has been already mentioned. It might, therefore, be expected that morbid states of the leucocytes would be associated with disorder of the lymphatic structures and connective tissues, of the red corpuscles, and of the blood-vessels, and this will presently be shown to be the case. The proportion of white corpuscles in the blood is subject to physiological increase, without becoming excessive, as after meals, during periods of growth and development, and in menstruation and pregnancy. This state is called *Physiological Leucocytosis* (Virchow), and signifies lymph-glandular excitement.

Plasma.—The physiological relations of the plasma to the organism are extremely complex; and disturbance of these relations furnishes many of the symptoms of disorder of the blood. Its mature *function* is essentially one of nutrition—it supplies the tissues with oxidisable material for development, growth, support, secretion, and the liberation of force. The *source* of the plasma is equally extensive. It derives its principal constituents from the alimentary canal through the absorbent glands and liver; while other important albuminous substances are being constantly supplied from the tissues generally, through the lymphatic system. Lastly, the *products* of the plasma, such as carbonic acid, urea, and water, are discharged by the regular excretory channels Thus the condition of the plasma is found to be most intimately associated with that of the organs and tissues generally, whether as regards its origin, its mature function, or its products; and it will therefore be affected by disorder or disease of every organ, whether alimentary, sanguifacient, or excretory, and of all the tissues.

Coagulation of the Blood: Fibrin.—Under certain circumstances, especially after removal from the body, the blood coagulates, and fibrin separates more or less completely from the other constituents. This change is now believed to be due to the action of three bodies contained in the plasma—two fibrin-generators, named respectively fibrinogen and fibrinoplastic substance, albuminous in nature; and the third a ferment. The *amount* of fibrin produced varies not only with the amount of these bodies, but with the amount of salts, with the degree of alkalinity and of heat, and with other influences; and these variations are subject to no law at present known. The *rapidity* of the process depends upon (1) the amount of ferment; (2) its increased activity by agitation of the blood and by elevation of temperature; and (3) the increased number of points of contact (so-called 'catalytic' action) by the presence of red corpuscles, hæmoglobin, charcoal, &c. It thus appears that the expressions 'amount of fibrin' and 'rapidity of coagulation,' however important as facts, do not afford any definite indication of the state of the blood, as has been generally believed hitherto. Three essential factors, and a large number of accidental influences, share in the process; they may do so in very various proportions and degrees; they do not vary together; the amount of fibrin is not in proportion to any one of them; and after coagulation is complete, portions of all the factors probably remain uncombined. The part played by the red corpuscles in coagulation is a double one—(1) the corpuscles, as 'points of contact,' greatly increase the rapidity of coagulation; and (2) they supply oxygen, which appears to be indispensable to the process. The leucocytes probably produce the ferment.

B. Pathology of the Blood.—The morbid states of the blood will now be considered in the following order:—1. Changes in quantity, and the effects of such changes upon the composition of the vital fluid. 2. Morbid conditions of the red corpuscles. 3. Changes in colour. 4. Melanæmia. 5. Morbid states of the white corpuscles. 6. The pathology of the blood-plasma; and of the process of coagulation. 7. The presence of foreign materials in the blood, including poisons and infective substances. 8. Organisms.

1. Changes in Quantity of the Blood.—Alterations in the total amount of blood in the body are perhaps never simple, but always associated with alterations in quality.

a. Polyhæmia, or *excess* of blood in the body generally, may be the result either of excessive ingestion of the elements of blood; of the accu-

mulation of the same by the suppression of habitual hæmorrhages or fluxes; of the loss or obsoleteness of a part of the body, such as a limb or a lung; or of insufficient exercise. It cannot be said, however, that polyhæmia has ever been demonstrated by exact investigation, inasmuch as the total amount of blood in the body is still uncertain, and the physiological limits in this respect are very wide. Polyhæmia is believed to be present in *plethora*, along with relative excess of the solids, and especially of the red corpuscles (*see* PLETHORA).

b. Oligæmia or *deficiency* of the total amount of blood is, on the contrary, an exceedingly frequent change, and constitutes the simplest form of *anæmia*. It is, however, probably never pure, inasmuch as alterations in quality appear to be inseparably associated with it; and the terms *hydræmia* and *spanæmia* have accordingly been used as synonymous with the preceding. The manner in which diminution in quantity gives rise to alteration in quality must be considered here.

When hæmorrhage occurs to any amount, and the whole quantity of blood in the vessels is reduced, the pressure falls, and absorption of the parenchymatous plasma rapidly follows; by which, along with vaso-motor stimulation, the physical relations are restored. If the loss of blood has been moderate, the only change in its composition may be considered to be *oligocythæmia*, or diminution of the red corpuscles, which alone of all the constituents of the blood cannot be rapidly restored. If the hæmorrhage has been more serious, the fluid absorbed into the circulation from the tissues, from the suppressed secretions, and from the alimentary canal, consists of water in ever-increasing excess, which carries with it an amount of salts equal to one-ninth the loss in albuminous substances. The morbid state of the blood is now beyond oligocythæmia; there is deficiency of albuminous constituents, or *hypalbuminosis*, and the condition correctly called *anæmia* is the result. The total quantity of blood probably remains for some time below the normal. A similar impairment of the quantity, and therewith of the quality of the blood, may be slowly developed by repeated small hæmorrhages, or by any cause whatever that impoverishes the blood, whether of the nature of waste or of want. The condition which results closely resembles that just described in the acute form—oligæmia with oligocythæmia and hypalbuminosis: the same is known clinically as *anæmia* (*see* ANÆMIA).

As a *therapeutic measure* oligæmia may be desirable. It may be induced either (1) by direct abstraction of blood, or (2) by gradual impoverishment of the blood, and reduction of the intra-vascular pressure.

2. Morbid Conditions of the Red Corpuscles.—The pathology of the red corpuscles is still imperfectly understood. The following comprise the most important changes connected with them so far as they are known.

a. Polycythæmia.—Increase in number of the red corpuscles is never considerable, being generally transitory and within physiological limits; for example, in the newly-born, and after meals. It has already been mentioned as associated with polyhæmia in plethora. In the algid stage of cholera the red corpuscles are relatively in excess.

b. Oligocythæmia.—Diminution in number of the red corpuscles is, on the contrary, of very frequent occurrence, and of the greatest pathological importance. Microscopically the number of red corpuscles in a given visible area of blood is diminished; and chemically the amount of hæmoglobin in a given volume of blood may fall from 15 even as low as 5 per cent. The principal circumstances under which oligocythæmia occurs are—(1) in anæmia, or diminution in the amount of blood as a whole, from any cause, whether rapid or protracted, especially as the result of fever; the red corpuscles suffering early, seriously, and persistently, as compared with the other constituents: (2) in leucocythæmia — the development of the red corpuscles being interrupted: (3) in hypalbuminosis, where the red corpuscles like other elements suffer from want of albuminous material: and (4) in chlorosis. *See* HÆMACYTOMETER.

c. Oligochromæmia.—Deficiency of the red corpuscles in hæmoglobin has been described by this name, and is a morbid condition of the greatest possible interest, inasmuch as it is one of the essential alterations of the blood in chlorosis. When the individual red corpuscle contains less hæmoglobin than normal, it is said to present a pale appearance to the eye. A more trustworthy method of determining the richness of the red corpuscles in hæmoglobin, is by means of the hæmoglobinometer (*see* HÆMOGLOBINOMETER). Or we may compare the amount of hæmoglobin in a given weight of blood with the number of red corpuscles in a given microscopical area. When the former is small in proportion to the latter, the defect must lie in the individual corpuscle; and this may be so great that the proportion of hæmoglobin falls, as in some cases of chlorosis, to 25 per cent. of the normal. *See* CHLOROSIS.

d. Aglobulism.—The effects of the two conditions of blood just described, namely, oligocythæmia and oligochromæmia, may be discussed together under the head of aglobulism, or deficiency of the blood in hæmoglobin. Want of the oxygenating substance of the organism gives rise to symptoms at once extremely various, and of the most serious import. Every vital process, whether developmental, plastic, secretory, dynamic, or nutritive, is absolutely dependent on a free and immediate supply of oxygen. All of these processes, therefore, will suffer in aglobulism. The respiratory and circulatory movements are accelerated. The complex processes of alimentation and secretion are performed imperfectly, and the results are dyspepsia, constipation, and disordered sanguification—which intensify the abnormal blood-state. Muscular contraction is feeble, and cannot be sustained. Psychical force is weak; and dulness, sleepiness, pains, and other symptoms indicate imperfect oxidation within the nervous system. Bodily growth and development—as of the sexual organs, for example—remain incomplete, and puberty is deferred. Nutrition everywhere suffers, the materials being insufficiently oxidised; and substances 'intermediate' to albumen on the one hand, and carbonic acid, water, and urea on

the other hand, are formed, especially oils. Thus the organs and the connective tissues become loaded with fat and enlarged, instead of suffering atrophy, as they do when the blood-plasma is deficient. Finally the excretions are disturbed, and the subject of aglobulism presents derangement of the colouring matters of the bile and urine, which are derived from hæmoglobin.

Histological changes. — Alterations in the *size, outline*, and *consistence* of the red corpuscle have been frequently recorded, but such accounts are incomplete, and no successful attempt has yet been made to connect any of these changes with morbid processes in the tissues. In severe fevers, such as typhus, and in some rapid malignant diseases, the red corpuscles appear peculiarly soft, their outline being less resistant and sharp, and the bodies running together into irregular heaps, instead of into *rouleaux* with well-defined lines of contact between the elements. In another class of cases the corpuscles appear small and crenated or like the 'thorn-apple.' *Macrocythæmia* and *Microcythæmia* have also been described as temporary and variable conditions, in which the red corpuscles are abnormally large and abnormally small respectively. *Transitional cells* between the white and the red corpuscle are unusually numerous in some cases of leukæmia.

3. **Changes in Colour.**—The colour of the blood is chiefly due to the red corpuscles, and alterations from the normal in this direction will be best considered in this place, although the white corpuscles and the plasma may also affect the colour, as will be presently shown.

a. The chief determining cause of the colour of the blood is the chemical condition of the hæmoglobin. When this is united with oxygen, in the arteries, the blood is *scarlet*; as deoxidation advances, this colour passes into a *purple*, and finally becomes *black* or venous. The dark colour is directly due to absence of oxygen. The purest example of this change is seen in asphyxia, where oxygen is excluded from the blood; but it also occurs as the result of the action of certain injurious influences upon the corpuscle itself, such as extreme heat, or poisoning by phosphorus, prussic acid, and other toxic agents. If the change proceed no farther, the scarlet colour may still be restored by oxidation. This blackness of the blood is generally associated with imperfect coagulation or even a state of fluidity (*see Fibrin*).

b. Paleness of the blood is observed in oligæmia and oligocythæmia, and is due to deficiency of the hæmoglobin.

c. The blood may be not only pale, but present streaks of a *puriform* character, even as it flows from the living vessels, as in leucocythæmia. The same blood will settle on standing into three layers—of plasma superiorly, loosely coagulated or not; of white corpuscles in the middle—a pus-like layer; and of red corpuscles at the bottom.

d. The *milky* appearance of chylous blood will be described under the head of *Blood-Plasma.*

e. Lake blood. The remarkable change in the blood in which it becomes lake or transparent, is frequently observed as a further stage of that first described above; but it may occur under other circumstances than deoxidation, and is of the very gravest significance, inasmuch as it indicates complete and hopeless destruction of the red corpuscles. Lake blood is no longer opaque, but transparent; the hæmoglobin has left the corpuscles and is dissolved in the plasma. The change can be effected experimentally by the addition to blood of water, chloroform, the bile-acids, or other solvents; and it is probable that some of the cases of rapid death after enormous draughts of water, and the destruction of red corpuscles that is believed to occur in jaundice, may be accounted for in this way. But the most important cause of 'solution' of the red corpuscles is complete deoxidation of the hæmoglobin, which is followed by its diffusion in the plasma. Thus drawn blood is rendered lake by the addition of sulphide of ammonium, phosphorus, phosphoric acid, or iron-filings; and the same effect is produced by the intravenous injection of salts of the bile-acids. This being so, it might be expected that blood would assume the lake appearance when exposed to the prolonged action of the causes that render it black: and recent observations seem to indicate that such is the case. In a number of diseases which are attended with the accumulation of oxidisable substances in the circulation, the blood has been described as 'fluid,' 'claret-' or 'cherry-coloured,' 'clear,' and 'staining the tissues,' —but apparently without more exact observations on the colour of the living plasma. Such diseases are high fevers, hyperpyrexia, insolation, and poisoning by malaria, phosphorus, and perhaps other agents. The effect of some of these influences is obviously to produce an excessive amount of oxidisable material in the blood, while the others may lead to the same result by reducing the oxygenating capacity of the corpuscles. Persons dying under such circumstances present great lividity, from the black or venous condition of their blood; death occurs with symptoms indicative of want of oxygen, as if so much of the hæmoglobin had been diffused through the plasma; and *post mortem* the vessels are found stained with the solution, the tissues are soaked with fluid lake blood, and decomposition is early and rapid. The 'fluidity' of, or absence of clot in such blood will be presently accounted for under *Fibrin.* That a similar solution or destruction of the red corpuscle may occur in all cases of fever, but in a much less degree, is supported by several facts:—(1) the increased discharge of potash-salts in fever; (2) a similar increase of the colouring matter of the urine; and (3) the anæmia that is found at the termination of the process.

f. Other alterations in colour may occur in the blood. The blood is *light-red* after poisoning by carbonic oxide, and remains so after exposure. It is *chocolate-coloured* after poisoning by the nitrites, such as nitrite of amyl; and other hues have been recorded.

4. **Melanæmia.**—In relation with the pigment-bearing element of the blood may be mentioned a morbid condition which has been described under the name of melanæmia. In it there are found in the blood black and brown pigment-particles and flakes, free or contained in cells of various shapes. This state is especially associated with two others, namely, malaria and an enlarged deeply-pigmented condition of the

spleen; and it is highly probable that the pigment-particles are produced by the fever, and find their way from the spleen into the blood. They are thus deposited in the liver and other organs, and give rise to symptoms of visceral disturbance during life, and to the peculiar slaty or grey discolouration that is found *post mortem*. It has been said that in melanotic cancer pigmented cells have been found in the living blood.

5. Morbid Conditions of the White Corpuscles.—The white corpuscles of the blood may undergo certain morbid changes both in number and appearance.

a. The most remarkable of these is *increase* in numbers, which may advance to such a degree that the white corpuscles become as numerous as the red. This condition is known as *leucocythæmia* or leukæmia (*see* LEUCOCYTHÆMIA). Short of this, however, the proportion of white corpuscles in the blood may be appreciably increased, and to this minor condition the name of *leucocytosis* has been applied. Leucocytosis, according to Virchow, accompanies, almost unexceptionally, every case of lymphatic excitement, such as inflammation, and tubercular, scrofulous, or cancerous enlargement or swelling of the glands and allied structures—Peyer's glands, the solitary follicles, the spleen, and the tonsils. Leucocytosis is distinguished from leucocythæmia by its very moderate degree; by its evanescent course; by the absence of deficiency of the red corpuscles; and by the accompanying symptoms. Leucocytosis may be appreciated even by the naked eye in the clot of drawn blood, by the presence of an irregular 'lymphatic layer'—*crusta lymphatica*, consisting of collections of white corpuscles between the red clot and the buffy coat which so frequently occurs along with it.

b. A *diminution* in the number of white corpuscles occurs in chlorosis; and, it is said, in malaria, especially during the paroxysm of fever.

c. With regard to the *structure* of the individual white corpuscles, the proportion of uninuclear or young cells, and of multinuclear or aged cells may be disturbed both in leucocytosis and leucocythæmia; while corpuscles may be found containing granules of various kinds, especially pigment-particles, bacteria, micrococci, and other structures.

6. Morbid Conditions of the Blood-plasma.—(1) WATER.—The limits of the physiological variations in the amount of water in the blood are very wide.

a. Diminution of water in the blood is observed in various degrees. It is moderate and transitory as the result of stimulation of the kidneys, skin, or bowels, but the normal proportion is speedily restored by absorption. This condition is found after severe purgation, sweating, diarrhœa, or dysentery; and its production is the rationale of several of the methods adopted for the relief of dropsy. If the drain of water continue, or if the supply fail, the anhydric condition of blood increases, so that the fluid appears black, thick, and tarry. Such is the state of the blood in the algid stage of cholera; the specific gravity of the serum rising as high as 1,080, accompanied by a comparative excess of salts, albumen, and urea. The chief symptoms of great deficiency of water in the blood are intense thirst; a shrivelled shrunken aspect of the body generally; coldness and lividity of the extremities; muscular pains; and suppression of the excretions—phenomena directly referable to loss of water, retardation of the circulation, and interference with the function of the red corpuscles.

b. Excess.—Hydræmia.—Reference has been already made under the head of oligæmia to the anæmia or hydræmia that follows it. Excess of water in the blood is perhaps never absolute, and the change may therefore be regarded with equal accuracy and greater convenience as deficiency of solids.

(2) ALBUMINOUS CONSTITUENTS.—On reviewing what has already been said under the head of Coagulation and Fibrin, the reader will observe that 'amount of fibrin,' and other expressions connected with the albuminous constituents, must be regarded at present as comparatively meaningless, in the light of our knowledge of the process of coagulation. Inasmuch, therefore, as little value can now be attached to the analyses of fibrin that have been made in different diseases, it follows that the estimates of the albuminous substances left after coagulation—that is, of the albumins of the *serum*, must also be rejected. But the total amount of albumins in the blood may be easily ascertained; and this is subject to extensive variations. The balance between the albuminous substances, which enter the blood from the alimentary tract and the lymphatic system, on the one hand, and the products of their transformation by the tissues, on the other, is represented by the albumins of the blood. These will increase accordingly when the supply is excessive, or the consumption small; and will decrease under opposite circumstances.

a. Hyperalbuminosis is the name given to *excess* of albumins in the blood. The amount has been found notably increased when the activity of the tissues is abnormally heightened, as for example in inflammatory diseases (acute rheumatism, tonsillitis, pneumonia, and pleurisy); and when fibrinogen, which is the product of this increased activity, is poured abundantly into the blood. The amount of albuminous fluid produced in an inflamed part, whether it appears as a catarrh, an infiltration, an exudation, or an effusion, is very great, and may be enormous; and, under favourable circumstances, this and much that cannot be so easily appreciated is carried into the blood, the lymphatic structures swelling *en route*. Hyperalbuminosis as a result of diminished consumption probably does not exist; for the effect of an insufficient supply of oxygen to the albumins—(want of exercise or over-feeding)—is not the accumulation of these in the blood, but the formation of 'lower' products, such as uric acid and its allies, and the deposit of fat. Relative hyperalbuminosis is a necessary but transient effect of cholera and other severe watery fluxes.

b. Hypalbuminosis, or *deficiency* of albumins in the blood, occurs under exactly opposite circumstances from the preceding,—whether the ingestion of albumins from the alimentary tract and the tissues be comparatively small, or the consumption excessive. Inanition, therefore, on the one hand, and its multitude of causes, are associated with such poverty of blood; and so, on

the other hand, are loss of blood, profuse discharges of albuminous fluids, morbid growths, and other sources of waste, as well as excessive demands of growth and development. The albumins of the plasma may fall under these circumstances from 80 to 37 parts in 1,000. Such hypalbuminosis is, however, never simple: the blood cannot be deficient in albuminous substances and otherwise normal, for, as we have already shown, loss of albumen is always followed by absorption of water and salts from the tissues in definite proportions, and anæmia is the result. The red corpuscles suffer at the same time, for their nutrition speedily fails in hypalbuminosis, and aglobulism ensues. Hypalbuminosis is thus a serious disease of the blood. The relations of these conditions to each other and to oligæmia are even more complicated clinically than they are pathologically: and in this relation the whole of them are most conveniently discussed under the comprehensive head of anæmia (*see* ANÆMIA).

(3) CLOT; FIBRIN. However uncertain as a measure of any particular constituent in the blood, the amount of clot or fibrin demands a brief notice as a matter of fact.

a. Abundant clot has been considered as indicating an excess of fibrin in the blood or *hyperinosis*, the proportion being stated to rise as high as 1·0 instead of 0·2 per cent. Acute rheumatism, cellulitis, pneumonia, and pleurisy are the diseases in which hyperinosis is most marked; but it also occurs in pregnancy. The two principal conditions of its occurrence appear to be—(1) Increased activity of the tissues—including inflammation; and (2) Free and abundant communication of these tissues with the blood through the lymphatic system.

b. Deficiency, looseness, or *absence of clot*—'*Fluid blood.*'—A small loose clot is frequently observed, as for example in typhous states, or in chronic wasting diseases attended with loss of blood; and has been described as indicating *hypinosis* or deficiency of fibrin. When the condition is extreme, the clot may be absolutely wanting, as in certain cases of anæmia: the blood then separates on standing into three layers — an upper, consisting of clear liquid; a middle, puriform, of white corpuscles; and a lower, red, of red corpuscles. In another and larger group of cases, non-coagulating or fluid blood is at the same time of an intensely dark colour or even lake, and is commonly described as 'black.' The circumstances under which this condition of blood occurs, and the cause of the remarkable colour have been already noticed; and it remains to account only for the fluidity. The profound alteration of the red corpuscles, the want of oxygen, the interference with the production of the ferment, and the changes in the fibrinogen and fibrinoplastic substance—one and all combine to prevent coagulation.

c. Buffy coat. Another phenomenon connected with coagulation, from which erroneous and even dangerous conclusions have been drawn, is the so-called *buffy coat.* The process of coagulation is generally sufficiently slow to allow of the gravitation of some of the red corpuscles from the surface of the blood; and the corresponding part of the clot is accordingly paler. When the pale layer is unusually large it is known as the buffy coat or *crusta phlogistica*: it may be seen in the blood in pregnancy, inflammatory fevers, hydræmia, and oligocythæmia. When these cases are analysed, it is found that the conditions favourable to the formation of the buffy coat are probably all more or less connected with the red corpuscles, namely—(1) increased specific-gravity of the red corpuscles, as in oligocythæmia and hydræmia—allowing more rapid sinking; (2) interference with the catalytic action of the hæmoglobin, which is so powerful in determining the rapidity of coagulation, as in fevers and oligocythæmia; and (3) want of oyxgen, corresponding to the amount and condition of the hæmoglobin, as in the same diseases. One and all of these states render the process of coagulation slow compared with the descent of the red corpuscles; and the buffy coat is the result. It thus appears that the buffy coat is no indication whatever of excess of fibrin-generators, or of the opposite; and that it is found under the most diverse conditions of blood.

(4) SALTS.—The amount of positive knowledge concerning morbid alterations of the salts of the blood is but small. It is to be observed that the salts of the plasma have chiefly sodium as their base, while potassium-salts mostly reside in the corpuscles.

a. Diminution.—In febrile diseases there is an increased discharge of compounds of both bases, but at different periods; the potassium-salts appearing in excess in the excretions until the crisis is past, and the sodium-salts during defervescence. At both periods, it may be considered certain that the blood is the chief source of the salts excreted; and that it is accordingly deficient in these constituents.

b. Excess.—On the other hand, the salts of the plasma are relatively in excess in hypalbuminosis, replacing, in the proportion already stated, the lost albumen. The effect on the salts of the blood of such drains as occur in cholera has been variously stated; some authorities declaring that it is an increase, others a diminution.

c. Reaction.—The alkalinity of the blood is said to be diminished in gout, cholera, and osteomalachia.

(5) FATS.—The normal increase of fats in the plasma that occurs after meals may be exaggerated by a diet rich in oil, and, it is said, in chronic drunkards and in persons disposed to obesity. When this increase is so great that the serum presents a milky appearance the blood has been called *chylous.* A cream-like scum forms on the surface of the serum; and the milky appearance is found microscopically to be due to the presence of fine granules and oil-globules. A marked increase of fatty matters in the blood has been found in some cases of chyluria. Fat may also appear in the blood as a foreign body, by the escape of marrow into the circulation in fracture of bones—and that in such quantity as to cause fatal capillary embolism.

(6) CARBONIC ACID, which exists in arterial blood in the proportion of 30 per cent., and in venous blood of 35 per cent., by volume, may accumulate within the circulation either by increased formation or by retention. Although associated with asphyxia, this increase of carbonic acid is

probably not the cause either of the symptoms of that condition, or of the dark colour of the blood that accompanies it.

(7) Other Constituents.—Amongst the most important of the other constituents of the blood, the following are to be noticed:—

a. Urea, which exists in normal blood to the amount of 1·8 parts in 10,000, may increase in uræmia by two or three times. There is still much uncertainty, however, on this subject (*see* Uræmia). Disease of the urinary organs, which interferes with the elimination of urea and allied products from the blood, is the usual cause of uræmia; but excessive tissue-change, as in fever and inordinate muscular exercise, has also the same effect.

b. Uric acid, found in normal blood in minute traces, is increased (as urate of soda) in all cases of gout, and may amount, according to Dr. Garrod, even to 0·175 parts in 10,000. Its presence is easily demonstrated by the thread-experiment (*see* Gout). Uric acid is also increased in leukæmia and chlorosis—probably from the imperfect oxidation associated with the condition of the red corpuscles.

c. Leucin, tyrosin, hippuric acid, sarcin, and other allied complex compounds, have been frequently found in the blood in small quantities, and the same may be said of *oxalic* and *lactic acids,* and of *acetone.*

d. Bile.—Certain of the constituents of the bile may occur in the plasma. The most obvious of these are the *bile-pigments—bilirubin* and *biliverdin,* which either by direct formation in the blood from the hæmoglobin, or more frequently by absorption from the liver, accumulate within the circulation, and by their deposit give rise to the colour of the tissues in jaundice. The *bile-acids—glycocholic* and *taurocholic acids*—are also under certain circumstances absorbed into the blood, where they may be detected with difficulty. They have a destructive effect upon the red corpuscles, and act further as a powerful poison to the tissues, causing the excessively severe symptoms that may occur in hepatogenous jaundice. *Cholesterin* is credited by some pathologists with being the cause of the same symptoms, and it has been found in the blood in increased proportion in some cases of severe jaundice.

e. Sugar.—The sugar of the blood is increased in diabetes, in some cases reaching 0·3 to 0·5 per cent.

7. Extraneous Matters in the Blood.—Besides its normal constituents and their products, the blood may occasionally contain certain matters entirely foreign to it, such as the numerous poisons which act either directly upon the corpuscles, or remotely upon the organism. These, entering the circulation before they exert their specific effect, are in many instances readily discovered by analysis. The acid compounds of hydrogen with sulphur, phosphorus, arsenic, and antimony, respectively, act as blood-poisons by depriving the oxyhæmoglobin of its oxygen; while carbonic oxide and nitrous oxide unite with the hæmoglobin, and expel the oxygen from the blood. It is a matter of speculation whether other so-called poisons, the nature of which is still obscure, do not enter the blood and there exert their primary effect, such as the contagium of acute specific fevers and other infectious disorders. Similar infective matters, produced in the tissues of the body itself, are believed to be absorbed in septicæmia, pyæmia, and other allied diseases, and numerous observations support the further belief that the presence of *bacteria* is intimately associated therewith. A somewhat similar infection may occur in malignant disease, the juices being mixed with the blood-plasma, but in some instances the process may be different, namely by means of cells. We cannot expect to detect these cells in the blood *in transitu.* The same remark applies to embola, of whatever nature, and to blood-crystals.

8. Organisms.—The blood may contain a variety of living organisms, either foreign or peculiar to itself; the latter being called *hæmatozoa. See* Hæmatozoa, Chyluria, and Relapsing Fever; also Bacteria, Filaria Sanguinis-hominis, Micrococci, Spirillum, and Zyme.

J. Mitchell Bruce.

BLOOD, Transfusion of. *See* Transfusion.

BLOOD-WORMS.—This term is of general application. It refers to all kinds of Entozoa living in the blood. *See* Hæmatozoa.

BLUE DISEASE. A condition in which the most prominent symptom is a peculiar discolouration of the skin and mucous membranes, due to the circulation of dark blood in the vessels. *See* Cyanosis; and Heart, Malformations of.

BOILS.—Synon.: Furuncles; Fr. *Furoncle;* Ger. *Furunkel.*

Definition.—Gangrenous inflammation of the skin, forming small painful swellings, and ending by expulsion of the necrosed centre or 'core.' The inflammation begins in the glandular structures, hence involving not only the skin, but also the cellular tissue immediately beneath. The sebaceous glands are most commonly the seat of boils, but occasionally the Meibomian glands (*stye*), the ceruminous glands, and the sweat-glands of the armpit; or, more rarely still, the glands of the lips, vulva, or anus are affected.

Ætiology.—The *predisposing causes* of boils are:—the male sex; middle life; a stout habit of body; seasons of spring and autumn; a diet too full of flesh, or one suddenly changed, such as that adopted during training for rowing, &c. To these must be added the vitiation of the blood during exhausting fevers and in certain cases of saccharine urine, or induced by inhaling dissecting-room effluvia; and dirty occupations, for example, chimney-sweeping or rag-picking. Lastly, boils are sometimes epidemic.

Local causes.—The parts of the skin most exposed to dirt or chafing, the hands and face, the neck and back, the buttocks and knees, are favourite sites for boils; but they may form on any part except the palms and soles. Blisters, poultices, and stimulating liniments occasionally cause them.

To these causes is added by some authors the specific contagion of a parasitic fungoid plant, the mycelium of which, by developing in a gland-cell, thereby causes limited necrosis (the slough) of the tissue in which it grows. The truth of this view is not yet clearly established.

Symptoms.—Boils appear either singly, in succession, or several at once, forming then an

eruption on the skin. The solitary boil begins with itching; soon a reddish pimple forms, sometimes tipped with a minute vesicle, in the centre of which a hair may generally be detected. The pimple grows larger and harder, the red area increases and grows darker, and pain begins, stinging at first, then throbbing. In about five days the summit breaks, pus oozes forth, the pain abates, and the hardness diminishes. A day or two later the core, a shred of sphacelated cellular tissue, escapes. The boil then subsides, and healing rapidly takes place; the scar is depressed, and for some time of a violet colour. Occasionally the inflammation affects chiefly the cellular tissue beneath the skin; the mass is then softer, more round and clearly circumscribed, and fluctuates like an abscess—this variety forms in the armpit. Rarely, the central slough extends rapidly beneath the surface, and communicates with the surface by several small apertures (*carbuncle*). In other cases the swelling is more diffuse; no core appears at the surface, but a hard very painful pimple is formed, which is long in subsiding (*blind boil*). The furuncular eruption, consisting of groups of small boils, forms successive crops, and thus the disease may continue a long time. Boils are generally limited to a small region, but this is not always the case; and the greater part, even the whole, of the body may be attacked.

The constitutional disturbance is usually *nil* or slight when the boil is due to local irritation, though it may suffice to render nervous, irritable persons unfit for work. When the boils are caused by exhaustion, the general symptoms are severe and denote great depression. Prostration, agitation, stupor, low delirium, dry brown tongue, sordes, vomiting, and diarrhœa set in, and the case often ends fatally; or recovery is very slow, accompanied by much suppuration. Septic absorption and pyæmia very rarely take place.

Carbuncular Boil of the Face.—There is a rare and often fatal form of boil, the determining cause of which is unknown. It is met with only on the head and neck, notably on the lip. Mild and trifling at first, like an ordinary boil, it rapidly extends by inflammation of the veins or lymphatics, and causes poisoning of the blood. The earliest sign of this fatal change is the occurrence of violent and repeated shivers. The boil becomes a boggy swelling of blackish violet colour; the surrounding tissues become hard and brawny; suppuration ceases; sloughing occurs; the complexion grows earthy; the features, if the boil is on the face, become everted; the skin round the eyes in some cases is puffed out, and the eyes themselves project from the sockets; anxiety and laboured gasping breathing set in; and a violent constricting pain in the head, chest, or belly is frequently experienced. Delirium and coma usually supervene, but sometimes consciousness and terrible suffering remain to the last. The duration from the first shiver to the end is about four days. The veins of the face first inflame, and the phlebitis extends by the veins of the orbit to the sinuses in the skull, to the diploe, &c.; hence abscesses form in the eyelid, the forehead, the meninges, or the brain, and occasionally in distant viscera.

Diagnosis.—A boil is distinguished by the central cavity and slough—characters peculiar to it. The boil of the face accompanied with phlebitis has been confounded in this country with the 'malignant pustule' of Continental surgeons. The former is still a *boil* with a central core. The '*pustule maligne*' is said to have invariably a large vesicle surmounting a brownish eschar, with a ring of smaller vesicles round the larger one,—a condition never met with in boils.

Prognosis.—When due to local causes, the prognosis is always good, unless the patient be exhausted by old age or fever; under such circumstances the extensive sloughing and suppuration often lead to a fatal issue.

Treatment.—*General.*—First remove predisposing causes, and invigorate the patient by change of air, outdoor exercise, vapour and Turkish baths. The diet should be moderate and mixed. Alcohol, unless the patient is greatly debilitated, should be given in very moderate quantity, and the form of fermented liquor most habitual to the patient is best; much alcohol taken before the core has loosened increases the pain and throbbing. Occasionally a saline purge should be given. Of empirical remedies, yeast (a tablespoonful thrice daily) is said to put an end to the repetition of boils. Quinine and perchloride of iron are also used. Quinine should be given to an adult in five-grain doses every six hours, till singing in the ears and headache begin; it should then be gradually lowered for three or four days to three or four grains per diem, and then left off. In obstinate cases the waters of Vichy, Barèges, or Harrogate are believed to remove the disposition to boils. In diabetes omission of sugar-forming food, and the free administration of alkalis are the most effectual remedies. For the exhausting boil of the face, large doses of brandy, with quinine, are required.

Local.—When signalled by itching, a boil may be stopped by plucking out the hair of the inflamed follicle, and in a long succession many boils may thus be prevented. When the areola has formed, if the pain be slight a drop of caustic solution applied to the centre will sometimes check the progress of the boil. A better plan at this stage is to cover the boil with a galbanum and opium plaster (Erasmus Wilson's) spread on leather. Under this treatment pain at once ceases, the inflammation gradually subsides, and the separation of the core proceeds painlessly; when the boil discharges, a hole should be cut in the centre of the plaster, for the escape of the products. When the pain is stinging, and the areola wide, with restlessness and headache, warm poultices are most soothing — those of starch cause pustulation less than linseed meal poultices. Mixing lard with linseed poultice, or sprinkling it with the dilute solution of acetate of lead, has a similar effect. Poultices hasten the expulsion of the slough, but should be discontinued as soon as the hardness changes to doughiness. If the slough is large, the surface may be dressed with lint spread with Peruvian balsam, and the boil carefully protected by means of pads and compresses.

Incisions are now much less employed than formerly. They increase rather than lessen the loss of tissue in ordinary boils, and do not

shorten the duration of the inflammation. They give relief to pain, however, and check the spread of diffused boils. When made, incisions should be free, crucial, or even star-like, and carried beyond the boil. In the rapidly extending boil of the face local treatment is of little avail; the free use of the actual cautery may be beneficial if employed at an early period.

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BONE, Diseases of.—Under this head are included:—Acute and Chronic Inflammation of bone and its membranes, with the consequences thereof, such as Caries, Necrosis, and Abscess; New Growths which arise both within and upon the bone; Malformations; and certain Disorders of Nutrition, namely, Hypertrophy and Atrophy. Bone-tissue should be regarded as being similar to other connective tissues, but some diseases affecting it are rendered obscure, while others are materially modified, by reason of its meshes being filled with lime-salts.

1. **Inflammation.**—As a matter of clinical convenience, it is usual to consider separately inflammations of the periosteum, of the bone proper, and of the medulla; but it should not be forgotten that these structures are throughout continuous and interdependent, and that disease is rarely exclusively confined to any one of them—it may originate or be chiefly developed in one, but it cannot long exist without involving the others to a greater or less degree.

A. **Periostitis**—*Inflammation of the investing membrane of bone* (*die Knochenhaut*). By periosteum is usually meant the thin fibrous envelope of the bone in which the vessels for the supply of blood subdivide. But between it and the bone is a layer of osteogenetic cells like the cambium-layer of a growing plant, and immediately external is a layer of cellular tissue, continuous with that of the adjacent parts; these are integral portions of the periosteum, and take an active share in all its diseased processes. Periostitis may be either *acute* or *chronic*.

(*a*) *Acute periostitis, osteoperiostitis, acute periosteal abscess*, or *acute necrosis*.—This is a formidable, but fortunately comparatively rare, disease, at least in the adult. It attacks the long bones almost exclusively, usually those of delicate children or young adults, in whom active bone-growth is still going on, and the periosteum is highly vascular. Acute periostitis probably never occurs without coincident inflammation of bone, and it is by far the most common cause of necrosis. It will be best to regard it as an acute ostitis and periostitis combined, and to call it *osteoperiostitis*, just as we call inflammation of the bone and of the endosteum *osteomyelitis*. The extent to which the bone and the periosteum are in the first instance respectively involved is always difficult, and sometimes impossible, to determine—it may be inferred from the extent of the necrosis. There are two ways in which the disease may begin—either in the fibrous investing sheath of the bone and the cellular layers beneath and superficial to it, from whence it spreads inwards to the cortical bone-substance, or even to the medulla; or in the bone-tissue—the inflammation spreading outwards to the periosteum. It is impossible in the living subject to distinguish acute osteomyelitis and osteoperiostitis arising from idiopathic causes. The disease is usually attributed to an injury, often slight, or to exposure to extremes of cold or heat. Frequently no cause is assignable.

PATHOLOGY.—Rapid exudation takes place in the layers of the periosteum, and in the Haversian spaces and canals of the bone, to such an extent as to obstruct the circulation, and probably to cause by pressure the severe pain complained of at the outset. The exudation beneath the fibrous layer of periosteum is copious, and soon becomes purulent; the periosteum is detached; the vascular supply of the bone is cut off; and necrosis results. The extent of the necrosis depends upon the extent to which the periosteum is engaged, while the thickness of the dead bone depends mainly on the depth to which the inflammation in the osseous tissue extends. Large accumulations of pus are often rapidly formed in these cases, the pus escaping through openings in the fibrous envelope into the circumjacent cellular tissue. The shafts of the tibia and femur are the parts most frequently affected; the disease occurs more rarely in the bones of the upper extremities and other parts of the skeleton.

SYMPTOMS.—One of the earliest symptoms of acute periostitis is sudden and severe pain in the affected bone, which is soon followed by intense fever. On the second or third day deep-seated swelling sets in, somewhat obscure at first. After an interval varying from five to ten days, the inflammatory signs approach the surface, the skin becomes œdematous, pits on pressure, and finally reddens and inflames. The length of interval depends on the thickness of muscles and soft parts covering the affected bone. Other things being alike in respect of pain and amount of fever, the longer the delay in the appearance of external swelling, the greater the probability that the bone is the first and chief tissue engaged, the inflammation having reached the periosteum secondarily, while the early appearance of swelling and fluctuation externally suggest that the inflammation is chiefly periosteal. Blood-poisoning, either septicæmic or pyæmic, is a common consequence of acute inflammation of bone and periosteum.

DIAGNOSIS.—This disease may be obscure at the commencement, and its nature overlooked; it has often been mistaken for acute rheumatism on account of the swollen joints, for phlegmonous erysipelas, for acute cellulitis, or for typhoid fever. The only malady with which acute periostitis need be confounded is an idiopathic inflammation of the deep-seated cellular tissue in a limb. This disease is rare. When we observe the chain of symptoms above described in a young person, we may safely assume the presence of an acute osteoperiostitis. The disease almost invariably terminates in suppuration and necrosis; resolution happens rarely, but necrosis is not inevitable, even after suppuration. In a few cases, especially in young children, if the matter be speedily evacuated, the abscess collapses, the periosteum reunites with the bone, and no necrosis takes place. This result is unfortunately quite exceptional.

PROGNOSIS.—This must be founded on the

extent of the necrosis; whether blood-poisoning has taken place; and whether the adjacent joints are implicated in the disease. Cure cannot take place until the dead bone is cast off or removed, and this is often long delayed. The usefulness of a limb may be permanently impaired by the disease, or it may require amputation, or the patient may lose his life altogether. On the other hand, the use of the limb, and the health of the patient, may become completely re-established.

Treatment.—Early and energetic treatment is of the greatest importance, as it affords the best prospect of averting the disastrous consequences of acute periostitis, but in hospital practice the cases are rarely seen sufficiently early. In the first stage the limb should be elevated, and ice applied; painting the limb with a strong solution of iodine is advisable. As soon as the nature of the affection is manifest, incisions down to the bone, so as to divide the periosteum, are indicated even before pus is formed. They relieve pain and tension, and, by permitting the timely escape of pus as soon as it does form, the amount of periosteal separation, and consequently of necrosis, is limited. It is the more important to make an early incision, because evidence of fluctuation is at first by no means clear or easy to make out, and this should, therefore, be done in all cases of doubt. Antiseptic precautions should always be taken. Sometimes the abscess-cavity does not readily collapse, owing to its walls being stiff and infiltrated, and its contents may become putrid, thus greatly increasing the patient's risks. If there be synovial effusion into a neighbouring joint, the limb should be kept at rest by means of a splint or a fixed bandage. When the acute symptoms subside, the abscess-cavity contracts, one or more sinuses remain, and the dead bone begins to separate (*see Necrosis*).

Where the epiphysis is engaged in the disease the case is more urgent; the fever runs higher, the suppuration is greater, and the degree of joint-implication more intense, proceeding in extreme cases to suppurative inflammation and destruction of the articulation. The œdema of the limb often indicates a deep-seated phlebitis, the precursor of septic poisoning. Under these circumstances, amputation of the limb is often the only resource. It is imperative to amputate where there is extensive bone-destruction, and the symptoms indicate commencing pyæmia; or where, with the death of a large portion of the shaft, one or both of the neighbouring joints has become gravely implicated, and great suffering and loss of strength forbid us to temporise. It is precisely in these cases, however, where the diaphysis has become necrosed up to the epiphysal junction, that good results are attainable by the immediate extraction of the dead bone. The shaft where it joins the epiphysis becomes rapidly detached and loose, and may easily be separated, while the bone can be divided with a chain saw beyond the limit of the necrosis in the other direction, and removed. It is difficult, however, in the early stages to diagnose the extent of the necrosis. Where the joints both above and below are involved, amputation is usually necessary.

A periostitis of a very acute form, almost invariably suppurating, and accompanied by necrosis, is very common in the fingers, where it chiefly affects the ungual phalanges. The pain is very great, but may be relieved by an early and free incision down to the bone, which, nevertheless, does not usually avert either suppuration or necrosis.

(*b*) *Chronic periostitis* is usually due to some diathetic cause, but may result from injury, or from some continuous pressure. It is most frequent on the superficial parts of the skeleton, as the tibia, clavicle, skull, and ribs, but may affect any bone; and it is often observed at the origin or insertion of muscles. When the disease arises from a general cause, such as syphilis, many parts of the skeleton are affected; when from a local cause, usually only one.

Symptoms. — Chronic periostitis generally takes the form of what is called a *node*—a tender, more or less painful, rounded or oval swelling; at first tense and hard, afterwards softer, or even fluctuating. The pain is much greater at the outset, from the tension of the parts involved, and is generally worse at night. Subsequently the swelling becomes indolent, and painless, unless pressed upon. Nodes are due to a localised inflammation. The cambium-layer of the periosteum and its external layer proliferate and become filled with leucocytes, thus forming a well-marked projection on the bone, which may undergo resolution, suppurate, or ossify, according to circumstances.

Prognosis.—In chronic periostitis this is usually favourable. Under the influence of early and suitable treatment, the inflammatory products are completely absorbed, and the bone resumes its natural shape. If the chronic inflammation of the periosteum be permitted to proceed unchecked, a deposit of new osseous lamellæ usually takes place on the surface of the affected bone, giving rise to permanent thickenings, or even to osteophytic growths. These are composed of light porous bone, with a rough surface. The skeleton of a syphilitic subject will often present numerous thickenings of this nature. On making a section of the bone, it is easy to see that the new bone is superimposed upon the old, and is formed by the periosteum.

Treatment.—When due to a local cause, the swelling will often spontaneously subside with rest to the part, but in obstinate cases iodide of potassium internally, and iodine ointment or blistering externally, may be required. If the subject be unhealthy, or if the original injury be considerable, suppuration may take place, when the treatment will be that of an *inflammatory abscess*. *Syphilitic nodes*, which are a very common expression of chronic periostitis, yield rapidly to the influence of iodide of potassium, which in some cases may usefully be combined with a mercurial course. Blistering or friction externally is hurtful in such cases. Syphilitic nodes are not at first prone to suppuration, and even when they become soft and fluctuating, and the skin reddens over them, they should not be mistaken for abscesses, as they readily become absorbed under suitable treatment.

(*c*) *Periostitis after typhoid fever.*—A peculiar form of chronic periostitis is occasionally observed as a sequel to typhoid fever. It occurs during

convalescence, and without general symptoms. It takes the form of hot, painful, and tender nodes, frequently symmetrical, and often placed on the tibia; the disease is also found on the ribs and other bones. It may be associated with necrosis, but if so the extent of the dead bone is small in proportion to the inflamed area of periosteum. The general health is not seriously affected, and the disease is very amenable to treatment by iodide of potassium, combined with iodide of iron.

B. **Osteitis** is an inflammation chiefly affecting the bone-substance; this form may also be *acute* or *chronic*.

(*a*) *Acute osteitis* is neither clinically nor pathologically to be distinguished from acute osteomyelitis or endostitis (*see Osteomyelitis*).

(*b*) *Chronic osteitis* is a disease beginning in the bone, in which the chief changes from first to last occur, the periosteum being secondarily engaged. This affection may result from injury, or be excited by exposure to cold; but it often depends on constitutional predisposition, such as the syphilitic, the strumous, the gouty, or the rheumatic diathesis, the first being the most frequent cause. It may occur in any part of the skeleton; the chief changes, when produced by syphilis, occur in the shafts of the long bones. They consist mainly of hypertrophy, and the bone is ultimately increased in thickness, in length, and generally in density: its interior is often transformed into dense bone-tissue, and the medullary cavity is obliterated. Another form, associated with the strumous diathesis, is generally seated in the joint-ends of the long bones, and in the spongy bones. It is prone to end in suppuration, accompanied by either caries or necrosis. The gouty and rheumatic forms are associated with evidence of the presence of either of these diatheses.

Pathology.—Increased vascularity first takes place, the Haversian canals enlarge, the canaliculi disappear, the cancelli enlarge to contain the inflammation-products, and the earthy matter diminishes; hence the inflamed bone softens, and, if macerated at this stage, will be found comparatively light and porous. When the inflammation affects the superficial laminæ of the bone, the periosteum becomes thick and vascular; if the deeper parts are involved, similar changes will occur in the endosteum. The porous condition of the bone may become permanent, when the condition is called *osteoporosis*, the result of so-called rarefying ostitis; or the granulations become transformed into new bone, and the cancellated structure is filled with osseous deposit, so that the whole of the inflamed area becomes very dense, and is then said to be sclerosed; or the inflammation-process may terminate in suppuration, followed by caries, necrosis, or an abscess of the bone, which last may be either diffused or circumscribed.

Symptoms.—These are insidious, very obscure at the outset, and may be mistaken for those of chronic rheumatism, or mere periostitis. They consist chiefly in aching, gnawing pain in the affected bone, with characteristic remissions and nocturnal exacerbations. The bone is tender on pressure, and feels increased in bulk at first, from the infiltration of the immediately surrounding soft tissues; subsequently the bone itself enlarges. There is often increase of heat in the limb. The progress is very chronic, and if unchecked by treatment may give rise to considerable deformity.

Treatment.—This should be directed to the cause of the disease. If this be syphilis, an antisyphilitic treatment will be followed by good results; even in chronic bone-inflammation, not dependent on syphilis, iodide of potassium is often of great service. Local counter-irritation may also be employed. Often the cause cannot be made out, and if iodide of potassium fail in producing an effect, we must fall back on general treatment. In the early subacute stage, rest, with elevation of the affected part, is very desirable. Warm fomentations, followed by iced compresses, relieve the suffering. If there be much pain and tension, leeches should be applied. Puncturing the tissues down to the inflamed bone with a tenotomy knife or fine bistoury, relieves the tense periosteum, and allows extravasation beneath it to escape, so that the pain is promptly abated.

(*c*) *Osteitis deformans.*—A peculiar form of chronic inflammation of bone has been described by Sir James Paget under this title, from the changes it produces, both in the form and density of the affected bones. It is a chronic osteitis of the most extreme type. It begins in middle age, and may continue for an indefinite time without influence upon the general health, which distinguishes it clinically from other bone-inflammations. It is usually symmetrical, and affects chiefly the long bones of the lower extremity and the skull. At first the bones enlarge and soften, from excessive production of imperfectly-developed structure and increased blood-supply, and, yielding to the weight of the body, become curved and misshapen, but the limbs, although deformed, remain strong and fitted to support the body. In its early period, and sometimes throughout its course, the disease is attended with pains in the affected bones, which vary widely in severity, and are not especially nocturnal or periodic. It is not attended by fever, nor associated with any constitutional disease. It differs from the chronic osteitis dependent on simple inflammation of bone or that produced by gout or syphilis, in affecting the whole length of the bone. Hyperostosis and osteoporosis dependent on these latter causes rarely affect the entire bone. No treatment appears to produce any effect upon this disease.

C. **Osteo-myelitis** is an inflammation chiefly affecting the interior structure of the bone. Like the former, it may be *acute* or *chronic*.

(*a*) *Acute osteomyelitis* or *endostitis* is a suppurative inflammation of the medulla and bone, which very frequently ends in septic poisoning and necrosis. It is nearly always associated with bone-injury, and most frequently happens after amputation, or gunshot fractures, in which the cancellated structure is injured; a severe contusion of the bone, an injury to the periosteum, or exposure to sudden extremes of heat and cold is capable, under some circumstances, of producing the disease.

Symptoms.—The symptoms are obscure, more especially if there be no opportunity of examining

the affected bone, as the changes in the bone are often masked by inflammation of the superficial parts. They usually make their appearance from five to ten days after the injury to the bone. The pain may not be excessive; there is fever and perhaps rigor. If there be a wound the secretion from it diminishes in quantity, and becomes less healthy; the medulla protrudes from its central cavity; the parts soon become surrounded by putrescent fluid; and the symptoms become those of more or less intense septicæmia. The periosteum sometimes, but not always, separates from the bone. In young persons the disease is sometimes arrested at the epiphysis; but in the adult the whole length of the bone is liable to be affected. The risk of septic poisoning is infinitely greater in osteomyelitis that in osteo-periostitis. Thrombosis of the bone-veins is especially prone to happen, and by the breaking down of the clot septic emboli are carried into the circulation, and deposited in the liver, lungs, and elsewhere. It is in this disease, too, that fatty embolism takes place—a condition associated with a very acute and fatal form of blood-poisoning. The prognosis is generally bad. It is impossible to distinguish acute osteomyelitis from acute osteo-periostitis, arising from non-traumatic causes. In military hospitals, in war time, acute osteo-myelitis is often epidemic.

Treatment.—Where the symptoms lead us to suspect osteomyelitis, although the medullary cavity of the bone may not have been exposed, it may be desirable to trephine the bone, and if suppuration in its interior be discovered, it will be necessary to amputate, and as soon as the nature of the disease is recognised, this affords the best chance of saving the patient's life. The chief difficulty consists in arriving at a correct diagnosis and deciding when it becomes necessary to interfere. This may best be done by observing the general progress of the case; and locally by the introduction of a probe into the medullary cavity when this is exposed. If it reach healthy bleeding medulla near the surface, we may temporise, if the constitutional symptoms admit of this; but it is rare for the disease once commenced to be limited—it has an extreme tendency to become diffused. Experience shows that nothing short of amputation at, or even above, the next joint is sufficient to arrest the consequences of the malady, and this must be done before the systemic poisoning has become marked. Amputation in the continuity of the affected bone is worse than useless.

(*b*) *Chronic osteomyelitis* is an obscure affection, not to be distinguished, either clinically or pathologically, from chronic ostitis. It may terminate in sclerosis, or in the formation of an abscess. *See* Chronic Osteitis.

2. **Abscess.**—This is a term applied usually to a limited suppuration in the bone, unattended by necrosis. Young adults are most prone to the disease, or boys about the age of puberty; it is very rare in women. It is the result of a chronic inflammation of bone, which may be associated with some injury. This affection is most frequently met with in the upper or lower extremities of the tibia, just external to the epiphysal cartilage, less frequently in the ends of the femur, only occasionally in other bones, and very seldom in the compact tissue anywhere.

Symptoms.—A circumscribed, slightly elevated, very tender and painful swelling may be discovered. This is due to a local periostitis with new bone-deposit, and the bone itself is often half an inch or an inch longer than its fellow, by reason of increased activity of growth at the epiphysis. The skin and superficial parts are unchanged at first, or there may be but trifling subcutaneous œdema. There is often slight local increase of temperature. The pain, on deep pressure at the central point, is often intolerable. It is intermittent at first, but generally worse at night. After a time it becomes continuous, and deprives the patient of all rest, owing to its severity. The abscess may persist with little change for months or years. The symptoms generally resemble those of osteitis, from which at the outset it is difficult to distinguish this affection. When the abscess tends to reach the periosteal surface, the soft parts become engaged, and there will be slight redness and œdema of the skin. Rarely the pus makes its way into the adjacent articulation, in which it sets up destructive inflammation; but usually the joints are free from implication. The subjects of the disorder have often suffered from antecedent bone-disease. Evidence of this should be looked for, as giving a clue to the diagnosis.

Treatment.—Spontaneous cure cannot occur—even if the abscess discharge itself, a permanent fistula will usually remain. It is necessary freely to lay open the abscess-cavity. A crucial incision must be made through the soft parts, down to the bone, at the most tender and prominent point, and a disc of bone removed by the bone-trephine—an instrument without a shoulder, about half-an-inch in diameter. The sudden loss of resistance indicates the piercing of the abscess-cavity. The layer of granulation-tissue lining its interior should not be interfered with, but the cavity simply washed out. The pus is often foul, and greenish in colour. The wound should be dressed antiseptically; granulations presently fill it, which are subsequently transformed into a fibrous cicatrix. Immediate and permanent relief follows the operation. If the abscess is missed, the trephine may be re-applied, or drill punctures made in the most likely directions in the adjacent bone, in order to discover the pus. Sometimes an error of diagnosis is committed, and the symptoms are found to arise from chronic osteitis, without suppuration. The operation, however, affords relief in these cases also. Where there is doubt, a preliminary course of iodide of potassium will often resolve it.

3. **Caries** is a form of chronic inflammation of bone, which has been likened to the process of ulceration in the soft tissues. It is generally found in the spongy bones, in any part of the skeleton, the vertebræ and tarsus being the parts most commonly affected. There are two forms of the disease—one, *simple caries*, resembles an indolent ulcer of the soft parts, is most common in the flat or short bones, but is sometimes met with in the compact tissue of long bones; the other, *fungating caries*, is often met with in the articular ends of the long bones, and usually

terminates in joint-disorganisation. It has been called *subarticular caries*; and is part of the disorder known as *tumor albus* (*see* JOINTS, Diseases of). The non-articular form of simple caries often originates in a localised periostitis, and is generally due either to syphilis or struma—the latter is most frequent in young persons, the former in adults.

PATHOLOGY.—In caries the bone gradually disintegrates as the result of a chronic inflammation of its cancellated tissue. The trabeculæ become infiltrated with leucocytes, and granulations form, which prove the source of purulent discharge, just as in a granulating surface of the soft parts; but the process is interfered with and delayed by the act of getting rid of the osseous structure, in the trabeculæ of which the cells remain shut up until the dead bone finally breaks down, and comes away in the discharges, being often distinguished in the form of gritty particles. Until this process is completed the dead bone is soaked in pus, which often becomes putrid, and until it is got rid of a healthy granulation-surface is impossible.

SYMPTOMS.—Caries is very chronic in its progress, and often causes extensive loss of bone, destruction of a joint, or loss of a limb. It is almost always associated with an impaired condition of general health; the adjacent soft parts are involved in the inflammation; abscesses form in them, generally connected with the diseased bone; these burst or are opened, and sinuses lined with gelatiniform granulations, and discharging a thin pus, persist for an indefinite time. On examination with the probe the surface of the bone is felt bare, rough, and much softened; and outside the area of carious bone periosteal deposits of newly-formed osseous tissue are often found. The diagnosis and prognosis depend upon the age, constitutional condition, and history of the patient, as much as on the local signs.

TREATMENT.—This must be directed to relieve the constitutional taint, as well as the local disease. Merely to excise or destroy the diseased portion of bone is not sufficient to cure the patient. Local means prove efficient only when the general condition has been sufficiently ameliorated, especially in the unhealthy chronic inflammation of bone frequently called strumous. Good air, good food, and tonics are, therefore, of great importance. If syphilis be present, an anti-syphilitic treatment must be pursued. The principle by which the local means act is to facilitate the formation of a healthy granulating surface—to transform, in fact, an indolent into a healing ulcer. The disintegration of the dead and diseased trabeculæ must be assisted. For this purpose the application of strong sulphuric acid diluted by two or three parts of water, or some other mineral acid, often proves useful. Partial gouging out of the diseased bone seldom succeeds, because of the injury done by the instrument to the adjacent bone, weakened as it is by inflammatory changes, and therefore prone to set up fresh disease. The complete *evidement* of the bone, leaving nothing but its thin outer shell, is more successful; but when the disease begins to invade adjacent joints, as in the tarsus, excision of the entire bone is best; or when several bones are involved, amputation becomes necessary. In children operations of this kind are not so often required; general treatment usually proves sufficient. In the early stages the actual cautery, applied over the most painful spot, is a valuable counter-irritant. It is undesirable to make early incisions into strumous abscesses in connection with diseased bone. It is better to empty them by a small trochar, and to preserve the diseased area as long as possible from atmospheric influence. When the carious action is arrested, the cavity fills with healthy granulations, the sinuses close, the parts cicatrise, and the gap in the osseous tissue is filled by fibrous, or sometimes by osseous material.

4. **Necrosis.**—The complete arrest of nutrition in a portion of bone from any cause is followed by the death or necrosis of the bone, and by a series of inflammatory changes in the adjacent parts, which result in the complete separation of the dead from the living tissue.

ÆTIOLOGY.—Necrosis is most frequently the result of acute bone-inflammation or severe injury, as after amputation, fracture, or contusion. It is especially prone to happen in the compact tissue, but it also occurs in the spongy structure, as the joint-ends of long bones, or the tarsus and carpus, where it is usually associated with more chronic forms of inflammation, and is more limited. The peculiar nature of the blood-supply to bone, and the facility with which it may be interfered with or arrested under the pressure of inflammatory changes, go far to explain the frequency of necrosis as a result of bone-inflammation. Acute suppurative osteoperiostitis or osteomyelitis rarely terminates without necrosis. Whether the dead bone will be in the superficial or the deep lamellæ depends on the seat of the inflammation, and on the extent to which the periosteum and endosteum are respectively implicated. The long-continued action of phosphorus, as observed in match-makers, and also of mercury, may induce necrosis. Syphilis is a frequent cause of necrosis, through its tendency to produce chronic osteoperiostitis, the sclerosed bone thus originated being afterwads prone to necrose. It is not an uncommon sequel during convalescence from some eruptive and continued fevers. After scarlatina, osteoperiostitis, followed by necrosis, is by no means rare, although affections of the joints are more common. It is probable that many cases of necrosis occurring in childhood are connected with an antecedent attack of scarlet fever. The nasal bones may necrose as the result of severe coryza, the vertebræ after pharyngitis, or the petrous portion of the temporal bone as a consequence of otitis. Arterial thrombosis and embolism are occasional sequelæ of typhus, and may produce a local gangrene, not only of the soft parts, but of bone. This is, however, more frequent in connection with typhoid fever. In endocarditis the nutrient artery of a bone has been observed to be obliterated by an embolus, thus producing necrosis.

PATHOLOGY.—After the death of a portion of bone, the living tissue, in immediate contact with the dead, becomes inflamed. The Haversian canals and canaliculi become distended with migratory cells; loops of capillaries form from the pre-existing vessels; a granulating surface, in fact, surrounds the dead bone in a manner precisely

similar to what takes place in the soft parts when a slough is being thrown off. The periosteum separates from the bone, becomes thick and vascular, while the osseous surface beneath is smooth and white, like macerated bone. In cases of syphilitic necrosis, as well as in that resulting from phosphorus, the surface is rough from antecedent periosteal deposit. How the osseous trabeculæ are dissolved or disintegrated over the surface of separation, so as to loosen the dead bone, is not certain. Probably the granulation-tissue that forms from the living bone possesses amœboid properties, and thus disposes of some of the bone-particles. The pus that is formed has a mechanical influence, while according to one theory lactic acid is produced, which transforms the insoluble into soluble salts of lime. While this loosening process is going on new bone, formed chiefly from the periosteum, is being deposited, constantly becoming thicker, and with one or more openings in it for the escape of pus, called *cloacæ*, so that eventually the dead piece becomes completely invaginated, and is named, from its position, a *sequestrum*. This sequestration of the dead bone is not invariable, as for instance in the spongy bones, the bones of the skull, and the upper jaw, or where from any cause the periosteum has been destroyed, no sheath of new bone will be formed. Necrosis very rarely takes placewithout suppuration; when this does happen the nature of the case is very obscure. Occasionally nearly the whole shaft of a long bone has been found necrosed, and after an interval of months or even years no suppuration may have taken place. Such forms of necrosis closely simulate malignant disease, and often they cannot be relieved or even recognised save after amputation. A chronic ostitis, followed by hypertrophy and sclerosis of the bone, is the most common antecedent condition of this form of necrosis.

Treatment.—The changes already described, which separate the dead bone from the living, do not cause its expulsion from the body. On the contrary, they shut it up, like a kernel within its shell, and nothing so imperatively demands surgical interference as the presence of necrosed bone. It acts as a foreign body, is a constant source of risk to the patient, and should be removed as soon as practicable. Its presence excites the periosteum to further formation of bone, so that the invaginating sheath becomes of great thickness in old-standing cases. The period at which an operation is usually undertaken is when the sequestrum has become loose, and the time required for this purpose varies with the extent and thickness of the necrosed bone. In the actively growing bones of the young the process of separation is accomplished more quickly than in the adult, especially when the sequestrum involves the epiphysal junction. Roughly estimated, a period of from three to six months might be named as that within which loosening of the sequestrum usually occurs. Beyond the latter term an effort to extract the dead bone should not be delayed, even if it cannot be felt to be loose. Among other risks involved in doing so may be that of amyloid degeneration of the viscera, principally the liver, kidneys, and spleen, which are subject to this change as the consequence of long-continued discharge from bone-disease. In order to remove a sequestrum, a director should first be introduced through a cloaca as a guide, and the soft parts sufficiently divided. An adequately large opening must now be made in the encasing sheath of new bone with the chisel, trephine, small saw, or cutting forceps, and the dead bone extracted, either in one or several pieces, as may be the more convenient The operation may prove difficult on account of great thickness of the soft parts or of the sequestral envelope, or because the sequestrum itself is extensive. After the removal of the dead bone the cavity fills with granulations, which subsequently ossify, and the soft parts cicatrise. Finally the sequestral envelope of new bone is partly absorbed, partly consolidated, just as the redundant callus is after fracture, and the bone tends more or less to resume its normal size and shape.

5. **Tubercle.**—An examination of some cases of chronic bone-disease in scrofulous subjects seems to prove their connection with the formation of tubercle in the bone. The medullary tissue in the joint-ends of the long bones, and cancellated bone generally, are chiefly affected. The external appearances are those of fungating caries; but microscopical examination discloses multitudes of round cells like lymph-corpuscles, with protoplasmic matter, filling up the interspaces. The cells are found surrounding the soft, gray, non-vascular patches, which are often seen on section of an inflamed cancellated bone in strumous individuals, the central part of which may be the subject of calcareous, fatty, or suppurative changes. The bone when so affected is never sclerosed; hence these are not simply cases of chronic inflammation. There is, however, some difference of opinion as to whether, in strictness, they should be called tubercular in their nature, and the inference that they are so rests rather on the general condition of the patient than on any purely local characteristic.

Treatment.—In cases of this kind general tonic treatment becomes of the greatest importance. Rest must be given to the affected part, and exercise to the body generally, combined with fresh air both day and night, and simple nourishing food. Where the bone is extensively diseased, it must either be excised, or the part amputated. The presence of the tubercular diathesis does not forbid an operation, the local source of irritation and drain upon the system being thus removed, and a healthy traumatic surface substituted for one infiltrated with inflammation-products. The removal of the local disorder often proves a comfort to the patient, and increases his chance of regaining health and strength.

6. **New Growths.**—The bones are liable to most of the new growths forming tumours found elsewhere in the body, such as cancerous, vascular, and other tumours. The most important are the following:—

a. Some tumours are peculiar to bone, as, for instance, the **Myeloid**, so called from the many nucleated corpuscles contained in it, analogous to those found in fœtal marrow; it is of endosteal origin, causing an expansion of the bone in which it grows. It is most common in the maxillary bones, and near the epiphysal ends of the long bones. It is generally observed in

young persons, requires removal, and extirpation, if complete, is not, as a rule, followed by a return of the disease.

b. **Periosteal or Fasciculated Sarcoma,** springing from the periosteum of a long bone, such as the femur, is not uncommon. The shaft of the bone may be seen on section passing through the centre of the tumour. Numerous bands of fibrous tissue, often ossified, radiate from the periosteum through the growth, like an outspread fan. The best treatment is amputation of the limb at the joint above, which does not, however, ensure against recurrence of the disease.

c. **Exostosis.**—This is a bony outgrowth developed on any part of the skeleton. It is difficult to distinguish cartilaginous from osseous outgrowths. The two structures are often mixed, and a tumour originally cartilaginous is often transformed into bone. Cartilaginous outgrowths, called **Enchondroses** are met with on the costal cartilages of old persons, also on the intervertebral discs, near the synchondroses, and arise also from the articular cartilages in rheumatic arthritis. Cartilaginous tumours, growing either from the periosteum or the medulla, have their favourite seat upon the phalanges; they are usually multiple, and from the deformity and inconvenience they produce often demand either enucleation of the tumour or, in extreme cases, amputation of the finger. The more special forms of exostosis are of two kinds, the *spongy* and the *ivory-like*. *Spongy exostosis* is often developed near the articular ends of the long bones, where it forms a nodulated outgrowth of cancellated bone of variable size, encrusted with a thin layer of cartilage, and having generally a bursa superimposed. This kind of exostosis is often connected with the epiphysal cartilage, and ceases to grow when the bone is fully developed. This fact, as well as the proximity of the neighbouring joint, renders surgical interference generally unnecessary, and often hazardous. Another form of spongy exostosis, sometimes called *osteophyte*, depends on a local excessive periosteal growth of bone. At first this outgrowth is porous, and but slightly connected with the bone on which it is developed. Afterwards it may become dense and hard from interstitial deposit, or it may always remain spongy. Such exostoses often depend on some local exciting cause, such as a blow; or they may be found at the insertion or origin of a muscle, as in the so-called rider's bone, at the origin of the adductor longus muscle, or the exostosis frequently found at the insertion of the adductor magnus, or the 'exercise bone' of the German soldier. They may be regarded as morbid exaggerations of the normal tuberosities of the skeleton. *Ivory exostosis*, so called from its dense, eburnated character, is more rare. It varies much in size, and may be pedunculated or sessile. Hereditary influence appears to exist in some cases, in others a predisposition to chronic periostitis, but there may be no apparent cause. The development is slow and painless.

Treatment.—Interference is seldom required in the spongy exostoses, except on account of pain or loss of function. When pedunculated they can be broken off or divided subcutaneously; and although they may reunite, it will probably be in a more convenient and painless relation to adjacent parts. Otherwise they should be excised.

Except on account of deformity, or of pressing on important structures, an ivory exostosis need not be meddled with. It can often, however, when necessary, be enucleated; and where only a partial removal is possible, the low vitality of the tumour often causes necrosis and subsequent exfoliation of the remainder. Spontaneous necrosis also occasionally occurs.

d. **Osteo-aneurism.**—Certain sarcomata and myeloid tumours, when very vascular, pulsate, and have been mistaken for aneurism. There are, however, undoubted cases of aneurismal tumours, dilating the bone, which have been cured by ligature of the main vessel of the limb. When the tumour is small it may be excised, or the actual cautery applied. Sometimes amputation is required. The causes and pathology of the disease are obscure. It is probably in some cases of a nævoid character.

e. **Bone-cysts** are tumours distending and thinning the bone, and filled with serum or bloody fluid. In some rare cases they contain hydatids. The origin of bone-cysts is obscure; some originate in the dentigerous cavities of the maxillæ, in which bone-cysts are most frequent, but they are sometimes found elsewhere. A very slow, painless increase in size takes place. The bone becomes gradually very thin, and often affords on pressure a peculiar and characteristic parchment-like crackling. In obscure cases an exploratory puncture should be made.

Treatment consists in freely laying open the cyst-cavity, and providing for subsequent drainage. The cavity gradually contracts and becomes obliterated.

f. **Hydatids.**—The formation of echinococcus-cysts in bone is exceedingly rare, compared with other parts of the body. The causes are unknown, and the symptoms very obscure, resembling those of an ordinary cyst. A cavity is formed, usually in the spongy extremities of the long bones, to contain the mother cyst. But it is also found in the medullary canal. The affection is grave. Serious inflammation often follows interference with these entozoa. It is sometimes difficult to remove the whole disease; and unless this be effectually done a relapse will occur; while in such parts as the pelvis art is unavailing. The cavity should, if possible, be freely laid open, and all the cysts carefully removed or destroyed. The actual cautery may be sometimes employed with advantage, or the surface of the adjacent bone removed, as it may be invaded by the cysts. An exploratory puncture can alone resolve the diagnosis, by finding the hooks of the acephalocyst in the fluid.

7. **Malformations.**—These consist in any departure from the normal type of the skeleton, by reason of excess, deficiency, or irregularity, either congenital or acquired. It is not necessary more than to allude to the fact, that the skeleton is often defective in parts; that senile changes occur, especially in certain bones; and that supplementary bones and processes are met with. Various deformities occur in bones from fractures, both intra-uterine and subsequent to birth, and from curvatures due to rickets or

softening. Treatment of curvature consists in gradual straightening by splints or other apparatus, or immediate straightening under chloroform, methods which, in the soft growing bones of the young, prove successful in abating many deformities. The curvatures of adult bones do not yield in this way. When there is loss or impairment of function from deformity, the bone may be safely divided subcutaneously with the chisel or saw, and the limb straightened—often with admirable results. Forcible fracture is a clumsy and somewhat dangerous method, as the force employed cannot be regulated.

8. **Hypertrophy** means an excessive growth of bone-tissue. Apart from inflammation this is rare, but in museums specimens of excessive growth are met with, especially of the bones of the face and skull. The causes are unknown, and no treatment appears applicable.

9. **Atrophy** consists in a diminution of the size or compactness of a bone. It may be the result of inflammatory changes, of senile degeneration, of disuse of a limb, or of an injury, such as a fracture followed by non-union. The bone-tissue gradually wastes away, the cortical portion often becoming a thin parchment-like layer of bone, filled with soft medulla. This has been called *excentric atrophy*. The external appearance and size of the bone remain unchanged. *Concentric atrophy*, where the size of the bone diminishes in all its dimensions, may occur in bones which have been disused for lengthened periods, as from paralysis of a limb, disease of a joint, or un-united fractures. *Spontaneous fractures*, or fractures due to trifling causes, are very common under these circumstances. The term *Fragilitas Ossium* has been applied to this condition of bone-tissue, which also frequently occurs in cases of cancerous cachexia.

10. **Softening.**—This change occurs in Rickets and Mollities Ossium. *See* Rickets; and Mollities Ossium. William MacCormac.

BORBORYGMI (*βορβορύζω*, I grumble).—Rumbling sounds produced in the abdomen by the movements of gas within the bowels or stomach.

BORDIGHERA in Italy, on the Riviera. A suitable winter residence for patients suffering from some forms of chest-disease. The climate is warm and dry. *See* Climate, Treatment of Disease by.

BOTHRIOCEPHALUS (*βόθριον*, a pit, and *κεφαλή*, the head).—A genus of cestode entozoa, characterised by the possession of two pits or depressions, one on either side of the head, in place of the four sucking disks usually present in tapeworms. The reproductive openings, instead of being placed along the margin of the so-called joints or segments of the body, occur at the ventral surface along the mesial line. Three species of *Bothriocephalus* are known to infest the human body. These are the broad tapeworm (*B. latus*), the Greenland tapeworm (*B. cordatus*), and the crested tapeworm (*B. cristatus*) recently described by Davaine. From a clinical point of view little need be said concerning them. The broad tapeworm is rarely seen out of Europe, and then only, it would seem, in persons who have travelled on the Continent. It is most common in Switzerland and north-western Russia; but cases also occur in Poland, Sweden, Holland, Belgium, the south-western provinces of France, and sometimes in Ireland. In reference to treatment, the parasite readily yields to the remedies employed in ordinary cases of tapeworm. In English practice we have generally resorted to male fern, but Dr. Arthur Leared has found kamela equally efficacious. *See* Tape-worm; and Tænia.

T. S. Cobbold.

BOTS.—A term employed to designate the larvæ of certain dipterous insects called gadflies. They more rarely infest man than animals. *See* Œstrus.

BOULIMIA. *See* Bulimia.

BOURBONNE-LES-BAINS in France. Common salt waters. *See* Mineral Waters.

BOURBOULE, LA, in France. Thermal alkaline and arsenical waters. *See* Mineral Waters.

BOURNEMOUTH in Hampshire. Regarded as a suitable winter residence for patients suffering from certain forms of chest-disease. The climate is mild and slightly humid. *See* Climate, Treatment of Disease by.

BOWELS, Diseases of. *See* Intestines, Diseases of.

BRAIDISM.—Synon.: Hypnotism.—Braidism is the name which, after its inventor, James Braid, has been applied to a therapeutic method destined to utilise the undoubted powers of mind over body for the cure of various diseases. In essence it consists of a species of Mesmerism, the patient being reduced to a partial or complete trance-like condition, by being made to look fixedly for a few seconds at a bright object held by the operator at 'about eight to fifteen inches above the eyes, at such a distance above the forehead as may be necessary to produce the greatest possible strain upon the eyes and eyelids, and enable the patient to maintain a steady fixed stare at the object.' The patient must be made to understand that he is to keep his eyes steadily fixed on this object, and his mind riveted upon the image of it. After so short a time as ten or fifteen seconds some patients may be intensely affected, and if so, it will be found, on gently elevating the arms and legs, that the patient has a disposition to retain them in the situation in which they have been placed. 'If this is not the case,' Mr. Braid writes, 'in a soft tone of voice desire him to retain the limbs in the extended position, and thus the pulse will speedily become greatly accelerated, and his limbs in process of time will become quite rigid and involuntarily fixed.' By slightly prolonging this process a condition of profound 'nervous sleep' may be induced, in which operations may be performed as easily and in as painless a manner as if the patient had been under the influence of chloroform. All this has been abundantly proved by Esdaile and others who performed numerous operations upon Hindoos, with absence of all pain, whilst they were in the hypnotic state. In his attempts to cure morbid conditions, however, Braid only rarely proceeded so far as to induce actual unconsciousness. Whilst in a semi-cataleptic condition the patient's attention is strongly directed to the

morbid part, and some very marvellous instances of relief are recorded by him, said to have been effected under the influence of this faculty only, without the aid of imagination, since some of the patients operated upon were quite incredulous as to any good being likely to result. In a recent work on 'The Influence of the Body upon the Mind,' Dr. Daniel H. Tuke remarks: 'Braidism possesses this great advantage, that while the Imagination, Faith or Expectation of the patient may be beneficially appealed to, this is not essential; the mere concentration of the attention having a remarkable influence, when skilfully directed, in exciting the action of some parts, and lowering that of others. The short period of time required, also, compares favourably with that consumed in some other forms of mental therapeutics. . . . The great principle which appears to be involved in all is the remarkable influence which the mind exerts upon any organ or tissue to which the Attention is directed, to the exclusion of other ideas, the mind gradually passing into a state in which, at the desire of the operator, portions of the nervous system can be exalted in a remarkable degree, and others proportionately depressed; and thus the vascularity, innervation, and function of an organ or tissue can be regulated and modified according to the locality and nature of the disorder.' Braidism certainly deserves more attention than it has received, though it is a method very difficult of adoption in ordinary practice, and which, however legitimate may be its foundations, would, unless the greatest care and vigilance were exercised, be apt to descend perilously near to the level of quackery. Still, if only half the results which have been attributed to Braidism would follow the systematic adoption of this method for the alleviation of many diseases, it is one which should commend itself to the earnest attention of future enquirers who may be able to place the practice upon a broader and firmer foundation than that on which it now rests. *See* MESMERISM.

H. CHARLTON BASTIAN.

BRAIN, Diseases of.—General Observations.—The range of unnatural phenomena which manifest themselves as the result of disturbed actions of the brain, whether from functional perturbations or structural disease, is wide and varied. This result is due to the fact that the brain, though spoken of as a single organ, is really a congeries of many distinct but functionally related parts; and further to the fact that this congeries of parts is continuous with the spinal cord and intimately related to a scattered network of ganglia—entering into the formation of the nervous system of organic life; whilst these several centres within and without the cranium are brought into connexion, through the intervention of nerves, with all other structures in the body, whether entering into the composition of the organs of relation, or into that of the visceral system.

The action of particular parts of the brain may be stimulated, depressed, or suppressed, and either of such altered modes of activity may entail a stimulation, depression, or suppression in the functions of one, two, or more distant parts of the nervous system. The first class of effects are spoken of as *direct*, and the second as *indirect* symptoms. It is often extremely difficult, if not impossible, for us to say which of the symptoms presented by a patient suffering from organic disease of the brain should be ranged under the one head and which under the other. Our ability to make such distinctions is at present hindered by our still incomplete knowledge concerning the anatomical details of the brain, the proper functions of its several parts, and the precise modes in which they co-operate with each other.

The effects of a shock, whether produced by injury or disease, falling on such an extensive assemblage of sensitive and mutually related organs are, as may be well imagined, subject to much variation; and as a matter of fact it happens that in different cases of structural brain disease, the symptoms produced are dependent upon three factors, viz., the *situation*, the *extent*, and the *suddenness* of the lesion. Except in so far as the nature of the lesion tends to entail variations in one or other of the above-mentioned respects, it is not of much significance from a clinical point of view (*i.e.* it does not lead to much difference in the sets of symptoms produced) whether we have to do with a case of hæmorrhage into, or with a case of softening of the brain. Thus the 'locality' and extent of the lesion in the case of a local disease of the brain has always to be enquired into as a problem altogether apart from that as to the more or less distinct nature of the pathological change in the part affected. In other words, the problem of diagnosis in brain disease is twofold; it must have reference to the region affected (Regional Diagnosis) and to the pathological cause (Pathological Diagnosis). The causes interfering with the progress of our knowledge in the former direction are both numerous and baffling, so that, as yet, comparatively little progress has been made.

SYMPTOMS.—The most frequent effects or symptoms of functional or structural brain-disease may be thus classified:—

1. PERVERTED SENSATION AND PERCEPTION.—The special senses of smell, sight, hearing, touch (fifth nerve), or taste may be interfered with by diseases of their respective nerves or primary ganglia within the cranium. Owing to the decussation of the optic nerves, disease of the optic tract gives rise (most frequently) to an affection of the sight of the opposite eye. The sense of taste pertains to different nerves. Thus the glosso-pharyngeal has to do with this special sensation in the back part of the tongue, the palate and fauces; whilst the taste-nerves for the front part of the tongue, though they pass from these parts with the lingual branch of the fifth, seem to leave it by the chorda tympani and then proceed to the brain with the facial or the fifth nerve. Disease of the intracranial portion of the fifth nerve may not affect the sense of taste, though it impairs the common sensibility of the tongue.

Disease of the primary ganglia of these nerves, whether they are separate (first and fifth) or lodged in the brain-substance at its point of connection with the nerve, will produce decided impairment of the several special senses. But

disease of portions of the brain above these regions on one side only, even though very extensive, often exists without disturbing the exercise of the special senses on either side. There may, however, be *Illusions*, *Hallucinations*, or *Delusions* in connection with either of these senses in many functional and structural diseases of the brain, where the morbid condition is situated in parts higher up than the primary ganglia, or where there is a functional exaltation of the ganglia themselves. This latter functional exaltation seems sometimes to be favoured by morbid states of some of the viscera—especially of the stomach, or of the uterus and ovaries.

Disease in the brain may also impair the common sensibility of the body, and in some of the most marked cases, this impairment is strictly limited to one lateral half of the body (Hemianæsthesia). It may be very marked and last for a long time; or it may be slighter and present only for a few days. There are several modes of impressibility comprised under the term 'common sensibility.' The principal varieties are tactile impressions, impressions produced by differences of pressure and of temperature, impressions yielding pain, and lastly those of the so-called 'muscular sense.' There is, moreover, a general sensibility pertaining to the muscles and joint-textures, and the last may be profoundly impaired in some cases. The writer believes that what there is of conscious impression pertaining to that endowment known as the 'muscular sense,' is compounded of the ordinary sense of touch and pressure pertaining to the skin, plus sensations in joints and muscles accruing from the contraction of the latter.

Besides diminutions of sensibility, we often have to do with disagreeable sensations of numbness, tingling, or actual neuralgic pains in parts. The two former may be widely distributed, though neuralgia from brain-disease is principally limited to the territory of the fifth nerves.

2. Perverted Emotion and Ideation.—These manifestations vary, from the mere increased tendency to emotional displays seen in a hysterical person or in persons suffering from hemiplegia, to those more complex aberrations met with in the various forms of delirium and insanity (*see* Insanity).

3. Perversions of Consciousness.—Under this head may be included the comparatively rare states known as somnambulism, ecstasy, and catalepsy; as well as the exceedingly common conditions of drowsiness, stupor, and coma. The former may be said in almost all cases to be associated with functional rather than with structural disease of the brain; at least, this is most in accordance with our present knowledge. Drowsiness, stupor, and coma are, however, amongst the commonest results of organic disease of the brain (*see* Consciousness, Disorders of), though they are also common conditions in blood-poisoning—whether arising from fevers, uræmia, or from poisonous doses of opium or of other narcotic or narcotico-irritant poisons.

4. Perversions of Motility.—These manifest themselves in many forms, which, however distinct they may appear to be, are, nevertheless, closely linked to one another.

Tremors may be general or local, and in the latter case they may be most marked in the tongue and facial muscles—principally those about the corners of the mouth or the orbicularis palpebrarum. General tremors may arise from debility, over-exertion, nervousness; or they may be due to alcoholic or mercurial poisoning, or to degenerative disease about the pons and medulla, as in Paralysis Agitans.

Twitchings may be characteristic of a highly nervous habit of body, and are especially frequent in some epileptics in the intervals between their fits, either in some of the facial muscles or in those of the neck or limbs. They may also occur in acute febrile affections, in which the functions of the cerebrum are involved, as shown by coexisting delirium, &c., and also in the course of many organic diseases of the brain. In chorea the irregular movements of different parts of the body are often of this nature; they may affect both sides of the body, or only one (hemichorea).

Spasms of a continuous or 'tonic' character are encountered in various diseases of the nervous system, such as laryngismus stridulus, trismus, hydrophobia, tetanus, hysteria, and some forms of hemiplegia and paraplegia. Such tonic spasms produce muscular rigidity, which has to be distinguished from that due to chronic changes apt to occur in paralysed limbs.

Clonic Spasms or *Convulsions* may be either unilateral or general, and may be induced by the most varied causes. When well-marked they are mostly attended by loss of consciousness, as in epilepsy and the majority of epileptiform attacks.

Co-ordinated Spasms, or movements of a struggling type, are met with in many epileptiform and hysterical paroxysms. Spasms of this type may be also limited to particular groups of muscles, as in the conjugated deviation of the eyes and neck occurring in hemiplegia, in wryneck, in writer's cramp, and other allied affections.

Paralysis may be local and limited in seat to some of the ocular muscles, the muscles of mastication, the facial muscles, those of the tongue, or to parts supplied by the spinal accessory and pneumogastric nerve, in those cases in which there is merely an implication of the intracranial portion of one or more of the motor-cranial nerves; or it may take an incomplete or a complete *hemiplegic* type, with lesions limited to one half of the encephalon; or it may be general, and involve both sides of the body, if a large lesion exists in the pons Varolii, or if the functions of both cerebral hemispheres or their peduncles are gravely interfered with. In some of these cases, and especially with right-sided paralysis, various difficulties exist in giving expression to thoughts by means of speech or writing (*see* Aphasia). Deficient action of the will (without obvious structural change of the cerebrum) may cause paralysis in hysteria and allied states.

Defective Co-ordination of muscular acts is met with, as in stammering and in some hemiplegic defects of speech; also in the body generally in some cases of cerebellar disease, producing a peculiar and unsteady gait (titubation) closely resembling that which may be met with in alcoholic intoxication. Similar motor disturb-

ances may be induced by vertigo of well-marked extent. Vomiting, again, is a reflex motor act due to impaired co-ordination, which occurs in many forms of brain-disease. More rarely the sphincter ani and the sphincter vesicæ become relaxed, or the bladder may be paralysed. But incontinence of fæces or of urine, or inability to void the urine, are comparatively rarely met with as a result of brain-disease, except in the comatose state, or in patients who are more or less demented.

5. Nutritive or Trophic Changes.—With lesions in the motor tract of the brain in or below the corpus striatum a band of degeneration is produced, occupying part of the crus cerebri, the pons, and the medulla on the same side, and (below the decussation of the pyramids) the opposite lateral column of the spinal cord. This is one of the most important of the trophic changes occasioned by brain-disease, because the degeneration in the lateral column of the cord is apt to spread to the contiguous grey matter, and thus to give rise to some of the trophic changes prone to ensue in paralysed limbs.

Trophic changes in other organs occasioned by some severe lesions in the brain appear as low inflammations and congestions of the lungs, or as hæmorrhages into these organs; also as hæmorrhages beneath the pleura or endocardium, or even into the substance of the suprarenal capsules or kidneys.

Again, we may have acute sloughing of the integument in the gluteal region on the paralysed side, dropsy of paralysed limbs, inflammations of joints and of the main nerves of paralysed limbs, and, though more rarely, marked atrophy of paralysed muscles. Retardation or arrest of growth is also apt to occur in paralysed limbs, when we have to do with infants or young children, suffering from severe organic brain-disease.

Blanching of the hair, or altered pigmentation of the skin, also occurs not unfrequently in connection with brain-disease or violent mental emotions; whilst in the insane the nutrition of the bones and of the pinna of the ear is apt to be interfered with.

6. Perverted Visceral Actions.—Exalted activity of the uterus, bladder, intestine, stomach, or heart, may be occasioned by functional brain-disturbance more especially; whilst the same brain-conditions may give rise to depressed or exalted activity of the liver or kidneys. With other functionally disturbed or emotional brain-states there may be a lowered functional activity of the salivary glands, of the heart, of the respiratory organs, of the organs of deglutition, of the organs of digestion, or of the sexual organs. These are only to be taken as mere indications of the kinds of modification that may be produced in visceral activity by brain-disease. Much doubtless remains to be learned in this direction.

It seems fitting here also to mention those contractions and dilatations of vessels which are apt to take place in different parts of the surface of the body, or in internal organs, from stimulation or contraction of vaso-motor nerves, occasioned either by direct or indirect influence exerted upon the principal vaso-motor centres in the region of the pons Varolii. These contractions or dilatations produce correlated alterations in the temperature, sensibility, and functional activity of the parts or organs affected. The temperature of paralysed parts, as well as the general body temperature, in the apoplectic state is subject to great variations, and these are now beginning to be studied more attentively. They are capable of yielding diagnostic indications of great value.

Remarks.—Some general remarks on the subject of structural and functional diseases of the nervous system, showing how intimately these two classes of disease are related to one another, will be found in the article Nervous System. Most of what is said there is applicable to diseases of the brain in particular; here, however, it is necessary to call attention to certain points specially related to brain-disease.

When paralysis occurs from brain-disease affecting one cerebral hemisphere, in the great majority of cases it is situated on the opposite side of the body, owing to the fact that the fibres conveying the volitional impulses to the muscles decussate in the medulla oblongata. It is true that many cases are on record in which the paralysis either has, or has been said to have existed on the same side as the brain-lesion. A certain number of these cases are probably due to errors either in the clinical or in the post-mortem records of the case. Others, however, still remain unexplained. The characters of the various forms of paralysis due to brain-disease are briefly set forth in the article on Paralysis.

Lesions of the left hemisphere much more frequently than those of the right, are associated with aphasic defects of speech; whilst, according to Brown-Séquard, lesions of the right hemisphere are more frequently and rapidly fatal than otherwise similar lesions of the left hemisphere. They are also more apt to be associated with acute sloughs of the skin on the paralysed side. Convulsions at the onset, and subsequent tonic spasms of the paralysed limbs, are also said to be more frequently associated with left- than with right-sided paralysis.

Congenital atrophy of one hemisphere, or atrophy occurring in early infancy, is mostly associated with an arrest of growth and development in the limbs on the opposite or paralysed side of the body.

Very little is positively known concerning the diseases of the cerebellum. Of its functional affections we may be said to know absolutely nothing. That is, of the various functional diseases of the nervous system with whose clinical characters we are familiar we are unable to name even one which we can positively say is a functional disease of the cerebellum. Whatever the precise mode of activity of the cerebellum may be, there is a general consensus of opinion that it is principally, if not exclusively, concerned with motility, and that it has more especially to do with the higher co-ordination of muscular acts. Atrophy of one hemisphere of the cerebrum is followed by atrophy of the opposite half of the cerebellum, so that there is a strong presumption that the functional relationship of either half is with muscles on the same side of the body. Clinically we know that disease of the cerebellum is not unfrequently associated with more

or less marked paralysis on the opposite side of the body; but this effect is now generally attributed to the pressure which structural diseases of the cerebellum are apt to occasion on the pons and medulla of the same side.

ÆTIOLOGY.—The principal modes of causation of diseases of the brain may be thus summarised:—

1. *Defective Nutrition* operates by modifying the proper constitution of nerve-tissues as well as the constitution of the blood, and thereby interfering with the normal functional relations of the several parts of the brain. Anæmia, chlorosis, syphilis, ague, and all lowered states of health, howsoever induced, and whether acquired or inherited, become predisposing or actual causes of brain-disease. To these states, favourable to the manifestation of brain-disease, should be added the various acute specific diseases, uræmia, metallic poisoning, poisoning by the narcotic and narcotico-irritant poisons generally, and also by the occasional qualities of certain articles of food, such as mackerel, mussels, mushrooms, &c.

2. *Emotional Shocks* cause cerebral disorder, especially in children, or prolonged overwork in those who are older—particularly when combined with worry and anxiety, with sexual excesses, or with protracted lactation. Religious excitement, again, not unfrequently leads to insanity.

3. *Physiological Crises*, such as the period of the first dentition, the period of puberty, pregnancy, and the climacteric period, all favour the manifestations of various nervous diseases.

4. *Visceral Diseases* or surface-irritations (especially in children or in persons having a very sensitive and mobile nervous system) may give rise to varied nervous diseases. Thus we may have convulsions or delirium in children from the presence of worms or other irritants in the intestines, or convulsions in adults during the passage of a renal calculus. Again we may have the phenomena classed as hysteria, or we may have nymphomania, in consequence of certain states of the sexual organs. Cases of paralysis are said also to have a reflex origin occasionally, though this must be a very rare event. With much greater frequency we find surface-irritations of various kinds leading, as in Dr. Brown-Séquard's guinea-pigs, to epileptiform attacks.

5. *Structural lesions* of the brain itself give rise to a very large proportion of its diseases. The various kinds of change will be found enumerated under another heading (*see* NERVOUS SYSTEM). Hæmorrhage and softening are the most common and, therefore, the most important of these morbid conditions.

6. Brain-disease may be determined by the action of *Heat* (*insolatio*), especially when combined with fatigue and deficient aëration of blood. A somewhat similar brain-affection, however, is occasionally developed in the course of rheumatic fever or in that of one of the specific fevers, in which the body-temperature rapidly rises to a lethal extent (109°–111° F.).

7. *Concussions* (whether from blows or falls) may give rise to brain-disease, even where no traumatic injuries or lacerations of the brain are produced.

TREATMENT.—The treatment of brain-disease will be discussed under the articles NERVOUS SYSTEM, PARALYSIS, CONVULSIONS, and those on the several special diseases which will now be described in alphabetical order.

H. CHARLTON BASTIAN.

BRAIN, Abscess of.—This term is applicable whenever a circumscribed collection of pus is formed in any part of the cerebral mass.

ÆTIOLOGY AND PATHOLOGY.—Amongst the most frequent causes of cerebral abscess are severe injuries to the skull, disease of the temporal bone in connection with the ear, ligature or obstruction of a main artery, and pyæmia. Under the three first-named conditions the abscess is usually solitary, but from pyæmia multiple abscesses often result. For practical purposes we may perhaps conveniently discard the latter—since the symptoms will usually be those of general encephalitis—and confine ourselves to those cases in which single large-sized collections of pus are met with. With this limitation, abscess in the brain is by no means of frequent occurrence.

The best marked, and also the more common examples of large brain-abscess are met with in connexion with compound fractures of the skull, and by far the most definite symptom which denotes them is the formation of a fungus cerebri. Unless in a compound fracture the brain be directly injured and the dura mater torn, it is very rare indeed for any suppuration in its substance to occur. It is not to be denied, however, that now and then, after severe concussion or laceration without external wound, abscess may follow. In such cases we may conjecture that usually some slight laceration or extravasation occurred in the first instance, which constituted a focus for the inflammation. Abscess after simple concussion without lesion is probably a most rare event.

In the article BRAIN, Inflammation of, we shall have to define Encephalitis as a diffuse change of a large part of the cerebral mass, perhaps of a whole hemisphere, attended by the infiltration of cells and fluid. It is obvious that the term abscess in the brain is applicable to one of the results of encephalitis, but it seems clinically probable that the two classes of cases are for the most part distinct, and that diffuse encephalitis has but little tendency to result in abscess, and that abscess is rarely preceded by a stage of encephalitis. Both are usually the consequences of local injury to the brain, or of extension from local disease of its coverings; but whilst encephalitis probably resembles the erysipelatous type of inflammatory action, in localised abscess this tendency is not present. Having distinguished brain-abscess from encephalitis, we must next say a word as to the risk of confusing it with intra-cranial but extra-cerebral collections of pus. Encysted collections of matter may be met with either between the dura mater and bone; or within the arachnoid cavity; and perhaps it ought to be added, though with some hesitation, beneath the arachnoid, in the pia mater. Not unfrequently inflammation of the membranes precedes and attends the formation of an intra-cerebral abscess, and in these cases the symptoms will be mixed. In dealing with published cases it is also necessary to be on our guard as to certain errors which have crept

in—cases of meningeal abscess being spoken of as brain-abscess. Mr. Prescott Hewett has expressed his opinion that the celebrated case of De la Peyronié's was an example only of extra-cerebral abscess. It is absolutely necessary to make these restrictions if we would judge correctly as to the symptoms which attend local collections of matter in the brain and the usual terminations of such cases.

Symptoms.—The symptoms of local suppuration in the brain will vary with the stage, the size of the collection, its precise situation, and, above all, with the presence or otherwise of a fistula of relief. In many of the cases which come under surgical care a fistula exists from a very early period, though not unfrequently it is liable to occlusion. Under the latter conditions the symptoms of a closed and an open cerebral abscess may be alternately studied in the same case. It will usually be observed that when the exit is closed and the abscess fills, the patient complains more or less, of headache, becomes heavy and drowsy, experiences twitchings or spasms in the opposite side of the face and limbs, with some tendency to hemiplegia. Of this group the tendency to spasms is probably by far the most significant. The headache may be but trifling, and the patient may even be well enough to leave his bed, when the occurrence of spasm followed by paresis alone gives warning of what is going on. The cases now alluded to are chiefly those in which abscess results from compound fracture of the skull with laceration of the brain-substance. In these the abscess often gives way spontaneously, and a fistula forms, around the orifice of which a mass of pouting brain-granulations, known as fungus cerebri, usually forms. In these cases the canal of communication may be very tortuous, and the liability to blocking considerable. Now and then the same result may be met with after syphilitic disease of the skull and meninges. The writer had some years ago a man under his care in whom he had opened a cerebral abscess beneath a hole in one parietal bone. The patient was able to walk about, and ailed but little so long as the fistula was freely open; but spasms of the face, or even convulsions of the limbs (on the opposite side) always followed its occlusion. The softening gradually extended, and he at length died in consequence, perhaps, of the impossibility of making a counter-opening in a depending situation. Unless the abscess be in the anterior lobe, there will almost invariably be present some degree of hemiplegia, but this will of course vary with the size of the collection and the extent of destruction of tissue. The formation of an abscess after injury is sometimes very insidious, the symptoms being very slight. The cases in which violent headache and pain, vomiting, delirium, and dry tongue, are said to have been present in the early stages are, the writer suspects, usually instances of suppuration between the bone and dura mater. These symptoms occur especially when brain-abscess follows disease of the internal ear, and in these there nearly always is the complication of inflammation around the petrous bone. Such symptoms are very rarely present in traumatic abscesses, which often develop very quietly until they attain a considerable size. It is probable that some degree of rigor, attended by rise of temperature, usually occurs in the beginning of cerebral abscess, but no very precise data are extant on these points.

The contents of a brain-abscess usually consist to some extent of broken-up cerebral tissue, and in some cases there are but very few pus-cells. Especially is this likely to occur when the so-called abscess follows on ligature of the carotid or occlusion of a cerebral artery. In these cases, it is in the first instance at least the result of a process of softening rather than of true suppuration.

If a large abscess be permitted to develop without relief, the symptoms of compression will in time ensue: first spasm, then hemiplegia, then hebetude and coma, preceded possibly by violent convulsions.

Diagnosis.—The diagnosis between cerebral abscess and meningeal abscess is exceedingly difficult, and often a guess is all that can be made. The almost invariable occurrence of spasm or convulsions in the former, and their frequent absence, with the greater degree of pain and headache in the latter, are the most reliable signs. Sometimes—as, for instance, when trephining has been practised, and no inflammatory products are found between the bone and dura mater or under the latter—the diagnosis may be helped by this negative knowledge. In such cases, if hemiplegia, preceded by spasm, have been gradually developed, the surgeon will be well justified in making an incision or puncture into the hemisphere. Optic neuritis may equally be present in both, and its presence or absence will scarcely help the diagnosis.

Prognosis.—In addition to the danger of death by compression, there is the risk that the abscess may break into the ventricles or into the subarachnoid space. Some cases are on record in which spontaneous openings into the nose or into the ear occurred, and profuse discharge followed, the patient in the end recovering. It may be doubted whether these were not instances of meningeal abscess.

Treatment.—It is needless to say that if abscess be diagnosed with any degree of confidence an opening is essential. There is little or no room for medical treatment. For the prevention of abscess, in all cases in which injuries likely to produce it have occurred, the utmost precautions should be enforced. Mercury in small doses, frequently repeated, should be given from the first; the injured region should be covered with lint soaked in a strong spirit-of-wine lotion, frequently re-wetted; purgatives should be administered; and the patient should be kept very quiet until long after the healing of the wound.

Jonathan Hutchinson.

BRAIN, Anæmia of.—Definition.—A condition in which the blood contained within the capillaries of the brain is deficient in quantity, or defective in quality.

The blood within the brain is contained in arteries, capillaries, and veins. The functional condition of the brain depends on the quantity and quality of the blood circulating in its capillaries, and it is to these that the special symptoms are related. Deficiency in the quality of the

blood supplied to the brain is always of gradual occurrence, and affects the whole brain; deficiency in quantity of blood may affect the whole brain or part only, and it may be sudden or gradual in its production.

ÆTIOLOGY.—*General cerebral anæmia* may be due to the following causes:—(1) It may be a part of systemic anæmia—defect in quantity or quality of the whole blood, and due to causes which are considered elsewhere. This is often seen in cases of hæmorrhage, of exhausting discharges, or of defective blood-nutrition, as in chlorosis. (2) The supply of blood to the brain may be deficient, the quantity of blood in the body being normal. This may be due to cardiac weakness, or to causes acting through the nervous system on the heart, as in swooning. In systemic anæmia, the lessened cardiac power increases the cerebral deficiency. Whatever lessens the amount of blood discharged from the heart at each systole, such as aortic or mitral disease, may be a cause of cerebral anæmia. Pressure on the vessels conveying the blood to the head, as by an aortic aneurism, has a similar effect. Unequal distribution of the systemic blood is another cause. The intestinal vessels, if dilated, are capable of containing a large part of the blood of the body, and the effect of their engorgement is often seen after paracentesis abdominis. One theory of shock ascribes its mechanism to vaso-motor dilatation of these vessels, and consequent anæmia of the rest of the system. The effect of each cause is increased by the action of gravitation in the erect posture. Some causes act only in that position. (3) The capacity of the cerebral vessels may be diminished by pressure on the brain, exerted by effusions of fluid (hydrocephalus), of blood (in cerebral and meningeal hæmorrhage), or by growths within the skull.

Partial cerebral anæmia is due to some obstruction to the passage of the blood through the vessels. To be permanently efficient such obstruction must be situated beyond the circle of Willis. Ligature of one carotid causes immediate symptoms of cerebral anæmia, but permanent symptoms are not frequent. Pressure on, or disease of one carotid, for the same reason rarely gives rise to symptoms. Obstruction in certain arteries of the brain may cause local anæmia, sudden or gradual, temporary or permanent, according to its cause. Such obstruction may be due to narrowing of the calibre of the vessel by atheromatous changes in its wall, or by spasm of its muscular coat, or may be due to actual occlusion by embolism or thrombosis. The pressure-effects of an intruding substance within the skull (tumour, or clot) act most intensely in, and may influence only one region of the brain.

It is obvious that of these causes some act suddenly, others gradually, and the symptoms produced will differ accordingly.

ANATOMICAL CHARACTERS.—The principal anatomical character of cerebral anæmia is pallor of the brain, observable chiefly in the paler tint of the cortical substance, and the diminished number of red spots in the white centre. The pallor may be partial or general. The membranes are usually pale, but in some cases of partial anæmia they are hyperæmic. Effusion of serum in the meshes of the pia mater and between the convolutions, may be found in general anæmia.

SYMPTOMS.—The symptoms of this condition vary according as the anæmia is suddenly or slowly produced, and as it is general or partial.

(1) In *sudden* general anæmia of the brain the sufferer feels drowsy; the special senses are dulled; noises in the ears and vertigo are complained of; the pupils are at first contracted; sight may fail; muscular power is weakened; respiration is sighing; the skin is pale, cold, and moist; nausea is common; and headache is rare. If the anæmia is more intense, consciousness is lost; there is universal paralysis; and general convulsions may occur, epileptiform in character, these being especially frequent in sudden extensive losses of blood in strong subjects. The pupils dilate, and the coma may deepen to death. The loss of sight in cases which recover may persist as permanent amaurosis.

(2) When general anæmia of the brain is *slowly* produced, the state of the cerebral functions is usually that of 'irritable weakness.' Their action is imperfect in degree, and excited with undue facility. There is mental dulness and drowsiness; sometimes, however, insomnia is troublesome. Delirium is common in severe cases, and is conspicuous in some forms of imperfect blood-nutrition, as in the so-called 'inanition delirium.' Headache, usually general, is a common symptom. Sensory hyperæsthesiæ, tinnitus, muscæ volitantes, and vertigo are frequent. Convulsions are rare, but muscular power is generally deficient. All these phenomena are more marked in the erect than in the recumbent posture, especially when the erect posture is suddenly assumed. It has been remarked that some anæmic persons can think well only when lying down. In young children, after exhausting discharges, as diarrhœa, symptoms referable to cerebral anæmia are common, namely, somnolence and pallor, with depressed fontanelle and contracted pupils. The somnolence may deepen to coma with insensitive conjunctiva, and the coma increase to death. Such symptoms have been called *hydrocephaloid*, from some resemblance to those of acute hydrocephalus.

(3) Partial cerebral anæmia causes, if complete, loss of function in the affected area; and if it be permanent, as in obstruction of a vessel beyond the circle of Willis, necrosis of the cerebral tissue results (*see* BRAIN, Softening of). If incomplete and sudden, there is temporary arrest of function. Ligature of one carotid, for instance, causes transient weakness and numbness in the opposite half of the body. There may be at first an over-action of grey matter, causing, in certain regions, unilateral convulsions. If slowly developed, as in atheroma of arteries, pain and vertigo are common, with recurring local symptoms, such as numbness, tingling, and weakness.

In all cases of long-continued cerebral anæmia, permanent damage to the nutrition of the brain may result. In the child the development of the brain may be arrested; in the adult, loss of memory and of general mental power indicate the deterioration of structure.

PATHOLOGY.—The symptoms are, as already stated, dependent mainly on the defective quantity

and quality of the blood circulating in the brain. Some influence may probably be ascribed to the diminution in the blood-pressure to which the nerve-elements are ordinarily exposed (Burrows). Nothnagel has pointed out that the symptoms indicate an early affection of the respiratory centre in the medulla, and of the cortical grey matter. Kussmaul and Tenner ascribe the convulsions in acute anæmia to the irritation of the medulla; Nothnagel, to that of the pons Varolii.

Diagnosis.—The diagnosis is not difficult. It rests on the recognition, in a given case, of the causes of cerebral anæmia; and on the exclusion of graver maladies, as organic cerebral disease. With the latter, it should be remembered, anæmia of the brain, local or general, often co-exists. Some symptoms of hyperæmia of the brain closely resemble those of anæmia. A common pathological state of imperfect blood-renewal probably exists in both conditions.

Prognosis.—The extent to which the cause of the anæmia is amenable to treatment, and is of transient character, must influence the prognosis. As a rule this is favourable when there is no organic disease of heart, vessels, or brain. In the so-called 'pernicious anæmia,' the prognosis is, of course, unfavourable. Hydrocephaloid symptoms in infants, if met by prompt and suitable treatment, are usually recovered from.

Treatment.—The treatment necessarily varies in the several forms of the affection, but it is in the main causal. The beneficial effect of the recumbent posture in affording immediate relief to the symptoms, and obviating permanent damage to the cerebral nutrition, must be always remembered. In acute anæmia from loss of blood, the head must be kept continuously low, stimulants freely administered, and as a penultimate resort bandages applied to the limbs from below upwards may increase the proportionate supply of blood to the brain. If this fails transfusion must be had recourse to. In chronic anæmia sudden change of posture should be carefully avoided, and ferruginous tonics are needed. In spasm of the cerebral vessels, bromides are useful. In the cerebral anæmia of syncope, the recumbent posture, stimulants to the skin, cold water, faradisation, sinapisms, and ammonia to the nasal mucous membrane, assist the recovery of cardiac action and the return of consciousness. In all cases, carefully regulated food and stimulants are needed; beef-tea should be given in small quantities, at frequent intervals. The group of symptoms called hydrocephaloid require similar treatment.

W. R. Gowers.

BRAIN, Aneurism of. *See* Brain, Vessels of, Diseases of.

BRAIN, Atrophy of.—Atrophy of the brain may be congenital, due to arrest of development in very early fœtal life; or the constituents of the brain may have been perfectly developed, and may subsequently disappear from one of several causes. This morbid state is regarded as *primary* when there has been no pre-existing disease of the brain or its membranes; *secondary*, either when there has been such pre-existing disease, and the atrophy has occurred from absorption of the part broken down by inflammation, softening, hæmorrhage, &c.; when atrophy of some special cerebral organ follows upon destruction of the particular nerve that arises from it; or when localised atrophy has taken place in a very gradual manner from pressure of a tumour, of ventricular effusion, &c. To take these forms in order:—

1. *Congenital atrophy.*—This is usually associated with weakness of intellect, even to the extent of idiocy: there is atrophy of the body opposite to the side of the cerebral lesion, and this atrophy involves all structures, even the bones. Paralyses of various intensity supervene, often with contraction of the paralysed parts; there being no particular sensitiveness of the special senses, possibly because of the mental hebetude. Epileptic attacks are common; vitality is low; and the patient easily succumbs to other diseases.

2. *Primary atrophy.*—In this variety there is general diminution both of volume and of weight, affecting most usually the cerebral hemispheres, and that in pretty equal degree. It is most common as a condition of old age—*senile marasmus, atrophia cerebri senilis.* It sometimes in earlier life follows exhausting diseases; and may also be caused by deficient or impure blood-supply to the brain. In close connexion with this mode of causation it is seen after repeated attacks of intoxication, especially after delirium tremens. In this last condition the cerebral atrophy may be acute and rapid.

3. *Secondary atrophy.*—This may be *general* or *partial*. When *general*, the convolutions have a shrunken appearance, and there is always an increase of the subarachnoid fluid. This condition follows various lesions of the brain, especially of the convex surface, such as hæmorrhage of the convexity, encephalitis, or more accurately that form of encephalitis that attacks only the grey matter or perhaps only one layer of the grey matter, as in some mental diseases. When the atrophy is *partial*, there are found depressions in an otherwise normal hemisphere, at which point a localised hæmorrhage or patch of softening, inflammatory or depending on thrombosis or embolism of vessels, has been absorbed, leaving only a cavity of greater or less extent, filled with fluid and sometimes lined with a thin membrane. A certain portion also of the brain may become atrophied by the gradual pressure of a tumour or any foreign body. Even the little sieve-like depressions seen in various situations after constantly repeated congestion of vessels may be the result of atrophy from compression by the distended vessels. Functional inactivity and atrophy of the optic nerves has led to a similar abnormality of the corpora quadrigemina.

Anatomical Characters. — The atrophied brain or portion of brain will vary in appearance on minute examination, according as the lesion has or has not been preceded by inflammation. When the atrophy is primary and due to gradual interference with blood-supply, there is seen a shrunken condition of the nerve-tissue, especially of the calibre of the nerve-tubes. The cells are smaller than usual and pigmented, the arteries being decreased in size or themselves diseased. If the lesion has had an inflammatory origin, the process in order of sequence is, first, inflammation, then softening with fatty degeneration, then partial absorption, and so atrophy;

the appearances differing according to the stage of the lesion. Traces of fatty degeneration of all the tissues,—vessels, nerve-tubes, and cells,—may be found, with the neuroglia either wanting or sclerosed.

Dr. Rudolph Arndt has lately thrown doubt on the possibility of determining atrophy of the ganglionic bodies or nerve-tubes by their size. The size of these bodies varies so greatly, within the limits of health, that he considers this test a very uncertain one. Almost the only trustworthy sign of atrophy, in his opinion, is the appearance in the substance of the ganglionic bodies and in the medullary sheath of nerve-bundles, of black shining globules, somewhat fatty-looking. In process of time these globules increase in number, and at last the whole of the bodies appear permeated by them. These globules are not fatty, they are certainly more or less pigmental. Exactly similar bodies appear at post-mortem examinations, and are a sign of simple decomposition. The duration of this condition, irrespective of pre-existing lesions, is protracted.

Symptoms.—The symptoms of atrophy of the brain necessarily vary according to the seat, extent, and ætiology of the lesion. Primary atrophy of the cerebral hemispheres and the first form of secondary atrophy will most usually induce imbecility, or some lesser degree of mental insufficiency, loss of memory, slowness of thought, and other mental diseases. Headache, giddiness, delirium, and stupor are seldom met with. Interference with speech is more common. Affections of sight, and of the motor condition of the eye, do not depend on general atrophy of the brain; they own a more local cause.

Convulsions, paralysis, stiffness of muscles, or contractions are often met with in connexion with this general lesion, as well as various irregularities of locomotion: but it must be remembered that general atrophy of brain is not seldom associated with atrophic or sclerotic lesions of the spinal cord, and even where this is not so, several of the morbid phenomena, and particularly convulsion and paralysis, may derive their origin, not from the atrophy, but from the condition pre-existent to the atrophy, such as hæmorrhage of the convexity, meningitis, or peri-encephalitis.

In secondary atrophy of a more limited extent, the symptoms are apt to be more strictly localised, such as partial loss of power in a single limb, slight imperfections of speech, or strabismus; but here again the positive diagnosis of atrophy is hindered by the complication of pre-existent disease, the local congestions, hæmorrhages, softenings, tumours, or other conditions of which the atrophy is only the sequence. Still less characteristic are the phenomena attending general or partial atrophy of the cerebellum, the pons, and the medulla oblongata.

Treatment.—Treatment is useless as to the atrophy of the brain: it must be directed to supporting the powers of the patient.

E. Long Fox.

BRAIN, Carcinoma of. *See* Brain, Tumours of.

BRAIN, Compression of.—The brain is compressed in the pathological sense whenever its structure is so squeezed that its functions are in any degree interfered with. This squeezing may be effected either by the effusion of blood within the skull, the growth of a tumour, the accumulation of pus or serum, or lastly by the depression of some large portion of the bony parietes. The general belief that depressed fractures are frequently the cause of compression is probably quite a mistake. In such cases the fragment displaced is rarely of sufficient size to cause serious compression of the contents of the skull, and the symptoms usually supposed to indicate that state are really due in most cases to laceration and contusion, or to subsequent inflammation. This point is of great importance in practice, for upon its recognition depends much of the validity of the reasoning by which the operation of primary trephining in compound fractures is defended or condemned. It also offers a most serious fallacy as regards the interpretation of the symptoms due to compression.

By far the best examples of uncomplicated compression of brain are supplied to us by the not very infrequent cases in which a middle meningeal artery is injured, and a large blood-clot is effused between the dura mater and bone. It is from observation of cases of this kind that the assertion is justified, that a very considerable intrusion into the skull is permitted without the production of any symptoms. No doubt the suddenness or otherwise has much to do with the results, but there seems good reason to believe that, as a rule, the brain will easily accommodate itself to quantities not exceeding an ounce or two, and that usually so large a quantity as four or five ounces is required to cause death. It is very rarely indeed that a depression of bone in the least approaches such an extent of intrusion as this, and the majority of such cases are, as regards the amount of possible squeezing, quite trivial. The manner in which the accommodation is effected is by the removal of the fluid contents of the skull, first the subarachnoid fluid, and secondly the blood. Of the blood-vessels the veins and venous sinuses are probably emptied first, and lastly the arteries and capillaries. A brain in a state of strong compression is an exsanguined brain. In this respect, the brain in the last stage of compression differs very much from that in cases of insensibility from concussion or contusion. It by no means follows that because the brain is pale, the face should be pale also; but it is perhaps usually the case that extreme compression so much enfeebles the heart's action that the pulse is weak or flickering, the respiration shallow and irregular, and the skin pale and cold. That stertorous breathing, a laboured pulse, and a suffused and dusky countenance, are (as according to the classical description) symptoms of compression, is probably for the majority of cases a mistake. Such a group much more frequently denotes laceration, contusion, or central extravasation. Nor is it true that hemiplegia, excepting of the most transitory kind, is often due to compression. A clot of blood poured out over one hemisphere may, if rapidly effused, produce for a while weakness of the opposite limbs, but the brain mass is soft enough to allow of considerable yielding, and in the course of a few hours the

effects of the displacement will have become general, and not local. In a case recorded by the writer in which a post-mortem, some weeks later, proved the presence of a large blood-clot, there had been partial hemiplegia without unconsciousness at first, but on the next day all trace of it had disappeared, and it never returned. In many of the cases of bleeding between the dura mater and bone, from the meningeal artery, the hæmorrhage takes place on several different occasions, with, it may be, intervals of a day or two, much as is often observed in wounds of arteries, such as the palmar arch. Thus the observer is able to appreciate the symptoms caused by different degrees of compression, and further proof is afforded that, if the intruded quantity be but moderate, the brain bears it without obvious inconvenience. Often at the autopsy it is quite easy to distinguish clots of very different dates, and to feel sure that the original one was of considerable size. It is clear then that in speaking of the symptoms of compression we must allow for differences in amount of the compressing substance, and also for differences in the rapidity or suddenness of its application.

When compression is produced instantaneously, as by a large fragment of bone driven down, the case is almost invariably complicated by contusion. If paralysis or even insensibility be present, it is usually impossible to say to which lesion they are really due. We may, however, hold it almost certain, from what we know of other cases, that the effects in such would be a temporary hemiplegia, with symptoms of shock if the depression were but moderate; and insensibility, probably soon followed by death, if the depression were very great. The cases in which depression of bone has alone been sufficient to produce long-continued compression with insensibility are possibly somewhat apocryphal. It is possible that compression under such circumstances might be attended by stertor and laboured pulse, but it is possible also that the pulse might be extremely feeble, the countenance pale, and inspiratory efforts weak and irregular.

The depression of bone is perhaps the only condition which can be supposed capable of producing compression suddenly. When blood is poured out from a ruptured artery, the symptoms come on rather gradually. The patient complains perhaps of headache, and then becomes more or less confused in manner, his gait is unsteady, and the limbs on the side opposite to the injury show special weakness. Vomiting may occur and the weakened limbs may twitch, and unless, as is often the case, the intracranial bleeding stops, these symptoms are soon lost in a state of complete insensibility, with pale face, feeble pulse, and symptoms of shock. Convulsions may now occur, and death often supervenes very quickly. In such a case the whole course of the symptoms may occupy less than an hour. The surgeon ought, of course, to trephine and let out the blood, and he must be prompt, or his patient may die during his preparations. More commonly this rapid termination occurs unexpectedly after one or more previous attacks of temporary head-symptoms, and the patient may have appeared quite well in the intervals. In cases in which the symptoms progress without interruption, their rapidity, no doubt, depends upon the size of the vessel ruptured. Certain special symptoms will also depend upon the precise position taken up by the clot which may chance to press upon special nerve-trunks as well as upon the brain-mass. In ordinary cases the clot is beneath the squamous bone and the lower part of the parietal, and passes downwards into the sphenoidal fossa. In the latter region it may press upon the nerves going to the sphenoidal fissure; and it is of importance for the surgeon to know that dilatation of the pupil on the affected side is often produced. This important symptom is probably due to pressure upon the third nerve.

There is yet another class of compression-cases in which that condition is produced by the slow accummulation of the products of inflammation within the skull. Much will depend, as regards special symptoms, upon the position of the abscess, either within or without the brain. If in the substance of the brain, it must more or less disorganise its structure, and thus cause symptoms due to laceration as well as compression. Under such conditions some degree of hemiplegia, with, probably, preceding spasms of limbs, can scarcely fail to be present. Now and then cases occur in which an irregular sinus leads into an abscess-cavity in the brain, and this sinus being sometimes free and sometimes blocked, the surgeon has repeated opportunity of estimating the effects of filling of the cavity. In such cases, headache, stupor, unilateral twitching of limbs, partial hemiplegia, with, perhaps, vomiting, and, it may be, general convulsions, are the symptoms to be expected. The position of the abscess as regards different regions of the brain is also of much importance, but its discussion cannot be entered upon in any detail here, and it obviously concerns rather disorganisation of structure than simple compression.

When a large accumulation of pus takes place between the bone and dura mater, the symptoms produced are much the same as those caused by blood-clot. We must make, however, much allowance for the fact that these cases are almost always attended by meningitis, and thus the symptoms of compression are masked by those due to inflammation. Chronic abscess under the bone without arachnitis may occur now and then in syphilitic and other disease of the skull-bones, but such cases are very rare. Such cases will differ from those of hæmorrhage in that the symptoms are always produced very slowly. The writer once had the opportunity of watching such a case, in which the patient died of compression, very gradually produced, and without any complication. The chief symptom was constant wearing headache, which prevented sleep. The man was pale and feeble, but not paralysed in any part, excepting that both eyelids drooped. He was rational, but spoke slowly, as if in a state of partial stupor. During the last two or three days of life he had convulsions, and finally, for twenty-four hours, he was in a state of increasing insensibility.

Diagnosis.—It will be seen from what has been said above that the diagnosis of compression by symptoms is exceedingly difficult, and that

the utmost use must in each case be made of the history of the case. In those of blood-compression after injury to a meningeal artery, there is almost always the fact that the patient between the date of the injury and the supervention of symptoms had an interval during which there appeared to be little or nothing the matter. This history is, if the symptoms have developed rapidly and without the signs of inflammation, by itself conclusive for diagnosis. Under such conditions trephining ought to be at once resorted to, or possibly it might be yet better practice to first tie the carotid artery.

The diagnosis of abscess in the brain-substance has already been discussed, and that of inflammatory collections from meningitis will be examined in its proper place (*see* MENINGES, Diseases of).

TREATMENT.—The treatment of compression of the brain is almost wholly surgical, and consists in the use of the trephine and knife to elevate depressed bone, or evacuate collections of blood or pus. JONATHAN HUTCHINSON.

BRAIN, Concussion of.—We class under the head 'Concussion of Brain' all symptoms which result simply from the shaking, more or less violently, of the contents of the skull. It will be obvious, however, that most cases of severe shake of the brain are likely to be complicated by visible lesions. The skull may be broken and the brain may be contused, lacerated, or ecchymosed. It is highly probable, however, that well-marked and even serious symptoms may be produced by shaking only, and without the existence of any lesion discoverable either by the unaided eye or the microscope. We must further clearly understand that this element of concussion (*i.e.* the results of shake independent of lesion) enters into almost every case of injury to the head. Whatever be the other lesions, it is usually the fact that the brain has been more or less severely shaken. Thus it may easily happen in cases in which conspicuous lesions are present, such as fracture of the base or local contusion, that still the results of the shake are the most important. It might be convenient if we were in the habit of speaking of most cases of severe injury to the head as *Concussion plus other lesions*, with the endeavour to assign to each added complication its proper share in the general result. These explanations are necessary before we put the question—Can concussion alone cause death? Although it is highly probable that we ought to reply with a very confident affirmation, and to assert that it is very common for concussion to be the chief cause of the fatal event, yet it is very difficult to prove it, since the cases are extremely rare in which severe concussion is produced without some attending lesion. The symptoms caused by concussion of the brain may be studied in very numerous cases of very various degrees of severity, which yet recover perfectly. From what is observed in these, we may infer as to the part which concussion takes in complicated cases many of which prove fatal.

The results of concussion may be divided into three stages—the first stage is that of *collapse*; the second, that of *reaction*, or of vaso-motor paresis, or, if named from its most prominent symptom, the *sleepy* stage; the third is that of *convalescence*, or recovery. The symptoms of the first stage, or stage of collapse, vary with the severity of the case, but if at all well-marked consist in feebleness of pulse, pallor of skin, coldness of extremities, and dilatation of pupils. They may approach a condition which threatens immediate death. There is no stertor, for the respiration is too feebly performed. Although the collapse may be very great, the insensibility is rarely quite complete. It is of great importance in this stage to establish the negative as regards all forms of paralysis. If any non-symmetrical symptoms are present, the case is more than mere concussion. During this stage nothing should be done, except placing the patient in a condition of comfort, and preventing the cooling of the body. Stimulants, unless the collapse is extreme, should be avoided. After the collapse has lasted some little time (half-an-hour to two, three, or more hours), it begins to pass off. The patient moans, manifests discomfort, turns on his side, and draws his knees up. Very often at this period sickness occurs, and it is almost invariable if the patient's stomach was full at the time of the accident. Consciousness is now usually restored, and, by rousing, the patient may be induced to speak, and will tell his name, &c. Gradually, during a period of some hours, the case slides on into the sleepy stage. The pulse is now relaxed and full, the skin is warm or even hot, the face may be somewhat flushed, and the pupils are contracted. The patient is overpowered with sleepiness, and can only be awakened with difficulty. It is, however, always within possibility to awaken him, and he usually rouses himself to the calls of nature. Very commonly the pulse is irregular, especially if the patient be young. At this stage again care must be taken to ascertain whether there are any non-symmetrical symptoms, any weakness of a limb, of one side of the face, or of any single eye-muscle. If the patient passes his urine or fæces in bed, or if there is long-continued retention of urine, it is very probable that there is more than mere concussion—namely, laceration or contusion. The sleepy stage may last for a day or for a week, and it is in severe cases so well-marked that the patient's eyelids may be held open, and the pupils examined, without awaking him.

During this stage the measures of treatment called for are spare diet, purgation, cold to the head, and quiet. When the sleepy stage passes off, the patient is left weary, torpid, unfit for mental effort, and often with distressing headache. These are the symptoms of the convalescent stage, and they may last more or less for a considerable time. The patient should still be kept carefully quiet, no stimulants should be allowed, and purgatives should occasionally be used. Some of the symptoms present during the stage of convalescence may persist so long that they may rank rather as sequelæ. Thus there may be for years nervousness, inaptitude for business, liability to headache, and peculiar susceptibility to the influence of stimulants. As a rule, however, even after very severe concussions, no such ill-results are left, but the patient regains after a time perfect cerebral health. This remark must, however, not be held to apply to

concussion when received in railway accidents; for in these cases there is a prospect of pecuniary compensation, and the sequelæ are often severe, prolonged, and very peculiar.

JONATHAN HUTCHINSON.

BRAIN, Congestion of. *See* BRAIN, Hyperæmia of.

BRAIN, Hæmorrhage into. — SYNON.: *Cerebral Apoplexy*; Fr. *Hemorrhagie cérébrale interstitielle*; Ger. *Hirnschlag.*

DEFINITION.—Escape of blood, by rupture of a vessel, into the substance or cavities of the brain. Hæmorrhage into the meninges is separately described.

Cerebral hæmorrhage is commonly due to the rupture of an artery, very rarely to that of a vein. Occasionally, minute extravasations are caused by rupture of capillaries. Hæmorrhage from arteries or veins may also be due to their laceration by injury.

ÆTIOLOGY.—Arterial hæmorrhage is usually due to the coincidence of weakened vascular wall and increased pressure within the vessel. The causes of these states may be regarded as the conditions *predisposiny* to cerebral hæmorrhage. Hereditary influence is sometimes distinctly seen, as a tendency to vascular degeneration, or to conditions which, as renal disease, produce such degeneration. Similarity of vascular distribution may also be inherited, and may determine the locality of strain, and, therefore, first of degeneration, and ultimately of rupture. Cerebral hæmorrhage is most frequent after fifty years of age, but occurs at any age, though rare during the first half of life. It is nearly twice as common in men as in women. It is said to be more frequent in temperate than in tropical climates, in winter than in summer, and at high than at low elevations. Certain acquired conditions act as predisposing causes. Chronic Bright's disease leads to early and extreme degeneration of vessels, as well as directly to hypertrophy of the heart and increased blood-pressure: hence it predisposes powerfully to cerebral hæmorrhage. In purpura and scurvy, cerebral hæmorrhage occasionally occurs—it is said in consequence of acute vascular degeneration and increased blood-tension. The state of vascular repletion known as plethora was formerly thought to be a frequent cause of cerebral hæmorrhage. It probably does aid other causes, but rarely co-exists with the most efficient, and so takes a very subordinate position. Chronic alcoholism and opium-eating are said to promote vascular degeneration.

The *proximate* causes of cerebral hæmorrhage are the weakened state of the wall of the vessel, and commonly some increase of blood-pressure. The vessel-wall is weakened by degeneration, and is often imperfectly supported in an atrophied brain. The increase of pressure within the vessels may be permanent, as in peripheral obstruction, with or without hypertrophy of the heart; or temporary, as in excited action of heart, or impeded circulation during effort. These causes are considered more fully in the article on BRAIN, Vessels of, Diseases of.

Hæmorrhage from a vein is rare, except as the result of laceration by direct injury, or of ulceration invading the vein secondarily. Varicose veins in the pia mater may sometimes rupture (Andral).

Capillary hæmorrhage is usually due to venous obstruction, especially to thrombosis in a vein.

ANATOMICAL APPEARANCES.—In intra-cerebral hæmorrhage, the blood is extravasated into the substance or into the ventricles of the brain—into the latter usually by rupture of a previous extravasation within the cerebral substance. In the latter situation the blood occupies a cavity formed by laceration of the brain-tissue; rarely, when very minute and 'capillary,' by merely separating the fibres. In size an extravasation varies from that of a pea or even smaller, up to that of the fist. The blood is clotted, and reddish-black in colour; and fragments of brain-tissue are mingled with it. The cavity containing it is often very irregular in shape; its walls are uneven, present projecting shreds of lacerated brain-substance, and are blood-stained and softened—at first by imbibition of serum, and later by inflammation. Many small extravasations are often seen in the neighbourhood of a larger clot. Usually there is only one large extravasation: sometimes, however, there are two or three. The extravasated blood exercises pressure; the convolutions are flattened; the falx is bulged to the opposite side (Hughlings Jackson, Hutchinson); and the rest of the hemisphere is anæmic. The effused blood may tear its way into the lateral ventricle; it then speedily distends both lateral ventricles and the third and fourth ventricles, and escapes by the openings at the lower extremity of the fourth ventricle, central and lateral, into the subarachnoid space. Or the blood may escape to the surface, infiltrate the pia mater, and tear its way into the subarachnoid cavity, often by a very small opening. It is rarely that the artery from which the blood has escaped can be detected. Occasionally the extravasation can be traced to the rupture of an aneurism of some size. In other cases miliary aneurisms may be found on many vessels. The larger arteries commonly present atheromatous changes.

After a time the extravasated blood undergoes changes. The clot shrinks and gradually becomes, first chocolate, then brown, and ultimately a reddish-yellow; and it then contains chiefly fat-globules, pigment and other granules, and hæmatoidin crystals. The rapidity with which it undergoes this change is doubtful, and certainly varies. It is said that the distinctive blood-colour has disappeared as early as the twentieth day. Meanwhile the walls of the cavity undergo changes. The inflammation, in rare cases excessive and purulent, is usually conservative, and leads to the formation of connective tissue. A firm wall is thus developed, the inner surface of which becomes smooth by the softening and removal of the loose fragments of brain-substance; by this means a cyst is formed. It is said that connective tissue may extend across its cavity, and that in rare cases, the fluid being absorbed, the cyst walls may unite, and a cicatrix result. Such cicatrices are, however, much more frequently due to softening than to hæmorrhage. It is asserted that a cyst may be developed in thirty or forty days under favourable conditions.

Hæmorrhage may occur in any part of the brain, but is more frequent in some situations than in others. The most frequent seat is the corpus striatum and the region just outside it: nearly half the intra-cerebral hæmorrhages are in this situation. Other primary seats, in the order of frequency, are the pons and peduncles, the cerebellum, the cortex, the optic thalamus (often affected by an extension of the hæmorrhage from the corpus striatum), the posterior portion, and the anterior portion of the hemisphere. The frequent extravasation into and outside the corpus striatum, is explained by the vascular supply. (*See* BRAIN, Vessels of, Diseases of.)

Traumatic hæmorrhage occurs into and from a lacerated portion of brain, and is most frequently found on the surface, occupying mainly the middle of the convex portion of each convolution, and some other regions much exposed to injury, as the surface of the temporo-sphenoidal lobe, and the under surface of the frontal lobe. Ventricular hæmorrhage sometimes results from traumatic rupture of a small vein on the surface of the corpus striatum (Prescott Hewett).

Soft tumours (especially glioma) are sometimes the seat of hæmorrhage. The distinction from simple hæmorrhage (sometimes difficult) rests on their position being commonly one in which cerebral hæmorrhage is rare; and on some gelatinous-looking tumour-substance being found, into which hæmorrhage has not occurred, and which has characteristic microscopic features.

Other organs may be healthy, or present the changes which have been mentioned as predisposing causes; the lungs are usually secondarily congested, often intensely.

SYMPTOMS.—The occurrence of cerebral hæmorrhage is indicated by cerebral symptoms of two classes, the one general and more or less transient, the other local and more or less permanent. In addition to these there are sometimes premonitory symptoms; and commonly general symptoms manifested by pulse, temperature, &c., which are secondary to the brain-lesion.

Premonitory symptoms, somewhat rare, are those of altered cerebral function due to local vascular disease, headache, vertiginous feelings, local weakness or numbness, slight mental changes, and slight affection of speech (*see* BRAIN, Vessels of, Diseases of, and BRAIN, Anæmia of). They are less frequent than in cases of softening, and more commonly precede cerebral hæmorrhage in the old than in the young and middle-aged.

The *onset* of hæmorrhage is usually accompanied with apoplexy, *i.e.* loss of consciousness and of power of motion and of sensation, often with relaxation of the sphincters and loss of reflex action (*see* APOPLEXY, CEREBRAL). These symptoms are profound and lasting according to the size of the hæmorrhage and its position; being especially marked in large and double effusions, in intraventricular hæmorrhage, and in hæmorrhage into the pons. In a case of moderate severity they last only a few hours, and gradually pass away. In severer cases they may deepen until death occurs from failure of respiratory power. Death is rarely very speedy, life being usually prolonged for some hours even in the most rapidly fatal cases. In rare instances of hæmorrhage into the medulla, and also in meningeal hæmorrhage, death has occurred in five minutes, probably in each case from the rapid interference with the respiratory centre.

The temperature is at first lowered one or two degrees, the pulse becomes less frequent, and the respiration slow. The Cheyne-Stokes respiratory rhythm often precedes death. After a few hours the temperature rises to the normal and in mild cases stops there, but in graver cases it rises above the normal two or three degrees. In some very grave cases the initial fall or subsequent rise may be extreme and go on until death occurs, sometimes reaching 90° in the one case, and 107° or 108° in the other (Bourneville).

In slight cases of cerebral hæmorrhage there may be no loss of consciousness. Vomiting in such cases is not unfrequent. In other rare cases of large hæmorrhage, especially between the external capsule of the corpus striatum and the island of Reil (Broadbent), the loss of consciousness comes on gradually, after other symptoms, as of shock, for example, have lasted for an hour or two. These cases have been termed *ingravescent*.

Local symptoms, often permanent, and always of longer duration than the loss of consciousness, are present in all cases of circumscribed cerebral hæmorrhage, except in the rare instances in which, by its central position in the pons and medulla, it causes directly bilateral effects only, which are added to and intensify the general symptoms caused indirectly. In a unilateral cerebral lesion, the direct symptoms are unilateral loss of power of voluntary movement and often of sensation, accompanied sometimes with convulsion or rigidity. These local symptoms may commence a few minutes or longer before the loss of consciousness. They coexist with the apoplectic condition, and may often be recognised, even during coma, by the flaccidity of the paralysed limbs, which fall more helplessly than those of the opposite side; by inequality of the mouth and of the pupils; by conjugate deviation of the head and eyes towards the side of the brain injured; by convulsive movements; and, as the apoplexy clears, by the detection of unilateral defect of sensibility. The coma passing away, these signs become more distinct, and all the symptoms of hemiplegia remain, varying in intensity and extent according to the position of the lesion. The apoplectic state may recur after its disappearance—a grave symptom, usually indicating that a fresh hæmorrhage has occurred in the same or the other side of the brain, or more frequently that the blood has escaped into the ventricles. In the former case the unilateral symptoms, conjugate deviation of the head and eyes, &c., are increased on the same, or transferred to the opposite side; in the latter the unilateral symptoms disappear, and general powerlessness and deep coma supervene, with stertor, relaxation of the sphincters, lowered temperature, and impeded respiration. Death always ensues.

Convulsion may be a conspicuous symptom at the onset or subsequently. It is usually unilateral in its course or commencement, beginning on the side paralysed, rarely affecting only the non-paralysed side. Where convulsion is

not met with, muscular twitching or rigidity may occur. General or widely-spread rigidity or twitching points to a bilateral lesion; if with coma, to ventricular hæmorrhage.

After a day or two symptoms of irritation about the cerebral lesion come on, such as headache, delirium, and rigidity in the paralysed limbs. During this period the temperature rises above the normal, and the pulse becomes quick. On their subsidence, these symptoms, if the lesion is slight, may be scarcely recognisable, and a stationary period ensues, at the end of which recovery of power over the paralysed limbs begins. In slight cases power may be recovered very speedily. Its return depends upon the structural recovery of slightly damaged tissue, and on other parts taking on an increased function in compensation for that which is destroyed. The electric irritability of the muscles exhibits little change. Sometimes, however, when there is great irritation at the lesion propagated downwards to the cord, a marked initial increase in irritability may precede a considerable depression, coincident with rapid wasting. Recovery of power is rarely complete except in those cases in which the area of damage is very small; and when the damage is large and affects an important motor region, there may be no recovery, loss of power persisting, commonly with more or less 'late rigidity' in the paralysed limbs. Slight permanent mental change often remains, and as the motor power is recovered, ataxic and other disorders of movement may supervene in the limbs which were paralysed, although much less commonly than after softening.

Diagnosis.—The diagnosis of cerebral hæmorrhage rests on the symptoms of a localised cerebral lesion, occurring suddenly. The conditions from which it has most commonly to be distinguished are—congestion of the brain; softening of the brain, embolic and thrombic; and, sometimes, tumour. For the distinction from it of other causes of apoplectic loss of consciousness, uræmia, post-epileptic coma, &c. *see* Apoplexy, Cerebral. From *congestion* the chief distinction of cerebral hæmorrhage lies in the transient nature of the loss of consciousness; and in the slightness and general character of the symptoms which characterise the former. Congestion generally, hæmorrhage only sometimes, comes on during effort: and the absence of history of effort is in favour of the latter. Similarly, the premonitory symptoms which are usually present in congestion, are generally absent in hæmorrhage. The loss of motor power, and the symptoms of cerebral shock, are much greater in hæmorrhage than in congestion. It must be remembered that the two states frequently coexist. From *softening* consequent on *embolism* cerebral hæmorrhage has also to be distinguished. The subjects of the latter are usually of an earlier age than those of hæmorrhage; their vessels are healthy, but they have organic heart-disease, which is often grave. There may be evidence of embolism elsewhere, in spleen, kidney, or retina. Loss of consciousness may be absent in embolism, and the paralysis often comes on deliberately. An extensive capillary embolism, causing deep coma, cannot be distinguished from hæmorrhage. From *softening* due to *thrombosis* the distinction is often difficult. Age, and the state of the vessels, no longer serve as guides. The presence of chronic Bright's disease is in favour of hæmorrhage. The occurrence of previous hemiplegic attacks points to softening. In the attack, loss of consciousness is much more considerable, in proportion to the subsequent paralysis, in hæmorrhage than in softening. But the distinction on this ground is often very difficult, since loss of consciousness may be absent in slight hæmorrhage, and considerable in an extensive softening. A deliberate onset is in favour of softening, and so are much mental change and early rigidity. Paralysis of sudden onset, in cases of *tumour*, may be ascribed to hæmorrhage, to which it is indeed sometimes, but not always, due. Usually, enquiry elicits a history of gradual, long-continued symptoms; intense headache and optic neuritis are strongly suggestive of tumour.

Hæmorrhage into the substance of the brain is distinguished from *meningeal hæmorrhage* by the pain and mental excitement being less conspicuous, convulsion rarer, and by the presence of symptoms of a local lesion. *Hæmorrhage into the ventricles*, which resembles meningeal hæmorrhage in the generality of its symptoms, is usually distinguished by succeeding the symptoms of a circumscribed lesion.

Prognosis. — During the attack itself the prognosis in hæmorrhage into the brain must be guided by the intensity of the symptoms, and by the place of the lesion, as far as that can be ascertained. Death is probable if the coma is profound or long-continued, and if the early depression, or the subsequent rise of temperature and pulse-rate is great. When the symptoms indicate ventricular hæmorrhage, or hæmorrhage into the pons, the patient will certainly die. Consciousness being recovered, and the danger of immediate death over, the freedom from much secondary pyrexia, from lung-congestion, and from bedsores, are favourable indications. The chance of recovery from the paralysis is estimated by evidence of position of the lesion, and by any indications of improvement. Early contraction of the flexors is unfavourable. The danger of recurrence is in proportion to the extent of vascular disease, and the existence of irremovable causes of increased arterial tension. Hence the prognosis is rendered unfavourable by advanced age, or chronic renal disease, and by the evidence of general premature decay.

Treatment.—*During the attack.* Rest is the most important. The patient should remain, as far as possible, where he is seized; stillness must be secured: and all effort is to be avoided. The posture should be recumbent, with the head raised. Any cause of passive cerebral congestion, such as a tight collar, must be looked for and removed. Venesection was formerly almost always employed in such cases—certainly too universally; but it is now quite discarded—perhaps too absolutely. Loss of blood lessens the force of the heart and vascular tension; it thus hastens the cessation of external bleeding. Doubtless it acts in the same way in internal hæmorrhage. It may be used with probable advantage if the arterial tension is great (that is if the pulse is incompressible), the heart acting strongly, and there is

reason to believe that the intra-cranial hæmorrhage is increasing. A small quantity of blood should be taken rapidly. In ventricular hæmorrhage, venesection is probably powerless for good. It should not be employed where there is any evidence of failing heart-power. Its indications are drawn as much from the state of the patient as from the fact of hæmorrhage. Bright's disease is no contra-indication.

If bleeding is not employed, the objects to be aimed at by other measures must be to divert the blood as far as possible from the brain, by relaxing the systemic vessels, while endeavouring to obtain contraction of the cerebral vessels. Warmth may be applied to the limbs, aided by sinapisms. Dry-cupping to the surface, and purgatives, as croton oil, will divert the blood to the surface, or to the capacious intestinal vessels. Drugs which would cause contraction of the vessels are to be avoided, since their influence being on the smallest vessels and universal, their tendency is to increase arterial tension and hæmorrhage. Contraction of encephalic vessels may be furthered by cold to the head or sinapisms to the neck, according as the head is hotter or colder than normal. The heart should be allowed to fall a little below the normal in force, but failure of power must be warded off by stimulants given with great care. Convulsion is more effectually checked by cold than by bromides; the latter may be given if the convulsion recurs.

After the attack.—During the stage of irritation, rest must be maintained, and all sources of annoyance must be avoided. The bowels should be kept gently open by laxatives or by injections. Stimulants must be avoided, and the diet should be light. Pain may be relieved by cold to the head, a blister to the neck, or by Indian hemp or by bromide of potassium.

During reparation the diet must be nutritious, but carefully regulated; and constipation of the bowels must be avoided. Rubbing of the limbs, and their gentle exercise, will aid their recovery, and after the symptoms of irritation have passed, faradisation will improve muscular nutrition, and is especially indicated where rapid loss of irritability indicates probable wasting. Nervine tonics are useful; none more so than a combination of hypophosphite of soda and tincture of nux vomica. In anæmia the syrup of the phosphate of iron is good. Warmth, change of scene, and cheerful mental surroundings are useful adjuncts, especially in the later stages of recovery. W. R. Gowers.

BRAIN, Hyperæmia of. — Synon.: Congestion of the brain.

Definition.—Increase in the quantity of blood within the capillaries of the brain.

Since neither the arteries nor the veins of the brain-substance can be over-distended with blood without capillary hyperæmia, and since it is to capillary hyperæmia that the functional disturbance of the brain is related, this may be justly taken as the essential pathological element in cerebral congestion. The congestion may be *active*, when the capillaries contain, in consequence of arterial distension or dilatation, oxygenated blood passing rapidly through them; or it may be *passive*, when, from venous obstruction, the capillaries contain slowly-moving blood, becoming, and in great part already, venous.

Ætiology.—(A) *Active* congestion of the brain may be *general* or *partial*. Of the *general* form the *remote* causes are as follows:—Men are said to be more liable to it than women. Age increases its frequency (but this is more true of the passive form); yet children, from the sensitiveness of their vaso-motor system, occasionally suffer from active cerebral congestion. Heredity has only an indirect influence. The plethoric condition is a powerful predisponent. The *immediate* causes of excessive flow through the arteries of the brain may be thus stated—(1) Increase in the blood-pressure—either general, from excessive action of the heart (as in extreme hypertrophy or functional overaction); or partial, from an obstruction elsewhere, throwing an undue proportion of the pressure upon the cerebral vessels. This is seen in contraction of the aorta beyond the origin of the vessels to the head, and in sudden contraction of a large number of the systemic arterioles, as those of the surface, in exposure to cold and in ague. (2) Active arterial dilatation of vaso-motor origin may result from prolonged mental work, severe moral emotion, insolation, digestive disturbances, or from the presence in the blood of various poisons, such as alcohol and amyl-nitrite. In these cases the vaso-motor disturbance may precede and cause, or may succeed and result from the overaction of the brain-tissue, which is intensified by it. In acute alcoholic poisoning the cerebral congestion is, as Niemeyer suggests, probably secondary to the disturbance of brain-tissue; in chronic alcoholism it may possibly be primary. In pyrexia the headache and delirium have been thought to be due to congestion, but this is not certain. (3) Increased atmospheric pressure may cause congestion of the brain. (4) And, lastly, gravitation in the recumbent posture may alone cause cerebral hyperæmia, or may powerfully aid other causes in producing it.

Partial active congestion of brain-tissue occurs chiefly along with disease of the arteries, which perverts blood-pressure; in organic brain-diseases, as tumour, hæmorrhage, &c.; and after blows on the head.

(B) *Passive* congestion of the brain, when *general*, is the result of impeded return of blood from the head. It may be due to pressure on the veins in the neck, as by tumours or tight collars; pressure on the innominate veins by tumours or aneurism; or obstruction to the circulation from violent respiratory efforts, as cough or blowing wind-instruments. It may be caused by impediments within the circulation, such as tricuspid insufficiency and its causes in the lungs, or disease on the left side of the heart. The recumbent posture assists all these influences. In arterial obstruction from diseased vessels, a weak heart, insufficient to overcome the obstruction, may permit venous stasis, but the capillary condition is one of anæmia.

Partial passive congestion may occur from thrombosis in a cerebral vein, or from pressure by a growth on one of the cerebral sinuses.

Anatomical Appearances.—The capillaries are not visible to the naked eye even when over-

distended, but with the microscope they are seen to be dilated, often to twice their normal calibre. Their distension is indicated by a deeper tint of the grey substance; and the fullness of the small arteries and veins shows itself in an increase, often very great, in the number and size of the red points visible on section of the white matter. In active congestion the arteries are said to be distinctly larger than normal, and their perivascular spaces lessened in size; the minute vessels of the meninges are distended. In passive congestion the veins and sinuses are gorged with blood. It must be remembered, however, that such engorgement of the veins occurs in all cases of death from interference with respiration, and that the vessels of the most dependent portion are always fullest. The state of the cerebral veins must therefore be carefully compared with that of the veins of other organs. Active congestion may sometimes leave no visible traces. After a time blood-pigment collects outside the vessels (Bastian), and serous effusion into the pia mater may be found; and after long-continued congestion, the vessels may be permanently distended; the spaces in which they run are increased in size. Such increase is common apart from pathological congestion, but it is so great in some cases of long-continued congestion that this effect cannot (with Moxon) be altogether denied.

Symptoms.—It is probable that many symptoms have been erroneously ascribed to cerebral congestion, some because hyperæmia, due to the mode of death, was found *post mortem*, others because an assumed congestion was the readiest mode of explanation. Moxon has indeed maintained that cerebral hyperæmia never causes symptoms except perhaps in death from strangulation. It is doubtful whether our knowledge of the conditions of the cerebral circulation is sufficiently exact to justify this conclusion, which is difficult to reconcile with clinical facts.

The symptoms commonly referred to cerebral congestion may be grouped in two classes—those of excitement, and those of depression. Either of these may exist alone; those of excitement may precede those of depression; or they may partially co-exist. They may be slight or severe; acute or chronic. In all cases they are increased by the recumbent posture or by depressing the head, by expiration, and by effort; and they are usually aggravated by constipation, and by indulgence in alcohol.

In *general* cerebral hyperæmia, among the symptoms of excitement may be mentioned mental irritability; headache—slight or violent, with feelings of fulness or throbbing in the head, and vertiginous or other unpleasant sensations; increased or perverted functions of the organs of special sense, such as flashes of light and noises in the ears; contraction of the pupils; sleeplessness, restlessness, startings, twitchings or slight actual convulsions; and mental excitement. The pulse is quick. There may be vomiting. The face varies, participating in the congestions of circulatory origin, and in some of vaso-motor disturbance, such as that which may occur during digestion. In other forms of supposed congestion of vaso-motor mechanism, as in those which result from excessive brainwork, the face may be pale, but the nature of these cases is doubtful.

Among symptoms of depressed brain-function are dullness of the special senses; motor weakness; mental indifference and slowness; somnolence, especially after meals; dilatation of the pupils; and infrequency of the heart's action. Consciousness may be lost suddenly, and the loss, it is commonly believed, may deepen into coma. As a rule there is no fever, but in children the temperature may be raised a degree or so.

In the *chronic* forms of cerebral congestion, these symptoms, variously grouped and moderate in degree, continue for days, weeks, or months. Their course is marked by great variability. Durand-Fardel has pointed out that in these cases there is often much viscid secretion of the conjunctiva.

In the more *acute* forms of cerebral congestion, the symptoms of muscular spasm, of mental disturbance, or of loss of consciousness, may be so predominant as to give a special character to the attack:—

In the *convulsive* form pain or uneasiness in the head commonly precedes the muscular spasm. The latter is usually slight. Consciousness may or may not be lost.

The *delirious* form is seen under two aspects—(1) in old age, after emotional excitement; in this the wandering is slight, and often related distinctly to the recumbent posture; (2) a much more violent delirium, which is apparently related to cerebral congestion, and is seen sometimes after mental work or emotional excitement, or after alcoholic poisoning. Occasionally death results.

The *apoplectic* form is marked by sudden loss of consciousness, occurring commonly during effort. The unconsciousness usually lasts only a few minutes, and incomplete general weakness remains for a day or two. In rare cases the loss of consciousness deepens into coma, with stertorous breathing and relaxed sphincters, and death may occur from the extension of the cerebral depression to the respiratory centres. *Vertiginous* sensations sometimes give a character to an attack.

In children congestion of the brain is a rare but occasional cause of convulsion or delirium. Headache and contracted pupils make up a group of symptoms resembling meningitis, but fever is rarely present, and if it exists it is slight, and the symptoms usually come on suddenly and pass away in a day or two.

Partial hyperæmia leads to localised symptoms of excitement or depression. Local convulsion or paralysis may result. Headache is often intense and localised. If nothing more than congestion is present, the symptoms usually soon pass off.

Pathology.—The pathology of cerebral congestion is still obscure, since we know little of the relative part played by the blood-vessels and the nerve-elements in determining the symptoms and their form. An excessive supply of arterial blood is, in all organs, attended with functional activity, and it is easy to understand that active congestion should result in symptoms of excitement. Subsequent depression of function has been accounted for by inferring compression of brain-tissue by effused

serum. The reaction of exhaustion may contribute. In passive congestion the nerve-tissue is imperfectly supplied with oxygenated blood, and compressed by distended vessels, and its functions are impaired by the presence of effete products. Hence the predominance of symptoms of depression over those of irritation.

Diagnosis.—The diagnosis rests on the discovery of circulatory and other causes of cerebral congestion; on the circumstances of posture, effort, &c., under which the symptoms came on; on the existence of concomitant congestion in other parts supplied by the carotids, as the face (by no means invariable); on the diffusion of the symptoms; on their speedy disappearance; and on the absence, in the adult at any rate, of elevation of temperature. The diagnosis of the special forms of cerebral congestion from the diseases which they most resemble is considered under the head of those diseases.

Prognosis.—The prognosis is generally immediately favourable, but from a severe attack death may probably occur. The apoplectic form is most dangerous, the convulsive least so. Degenerated weakened vessels render the immediate prognosis less favourable. After many attacks, permanent nutritive changes in the brain supervene.

Treatment.—The most important elements in the treatment of cerebral congestion are posture, removal of blood, purgation, cold to the head, and warm and stimulating applications to the surface. Whatever be the cause, it is important to raise the patient's head, so that gravitation may impede the flow and aid the return of the blood. By this means alone insomnia from hyperæmia may often be prevented. The removal of blood is useful in extreme forms of congestion, either active or passive, especially in those forms of active congestion in which the face participates. Venesection or leeching may be employed according to the severity of the attack; in active congestion the blood which is taken should be removed quickly. The relief which in such cases follows an epistaxis illustrates the value of this method of treatment. It is not advisable in those cases in which, from overaction of brain-tissue, or from cold to the surface, dilatation of the cerebral vessels results, while the face remains pale. In all forms of congestion, purgation is useful. It removes from the blood some of its serum, and it affords immediate relief to the cerebral circulation, by causing an afflux of blood to the capacious intestinal vessels. In plethoric states diuresis is also most useful, and has succeeded where venesection and purgation failed (Reynolds). Cold to the head is of most value in reflex or secondary dilatation of the cerebral vessels, as after mental work, insolation, fatigue, and some toxæmic states. In the same class of cases, stimulation of the peripheral nerves by sinapisms, blisters, &c., applied to the neck, will, by reflex influence, assist in obtaining arterial contraction. Hot applications to the limbs act in part in a similar manner, in part by causing local afflux of blood and thus lessening the tendency to encephalic engorgement. They are most useful in active congestion. Alcohol and opium must be avoided in all forms of active congestion, but in passive congestion they may be of service. Bromide of potassium is useful in those cases in which the congestion is produced by vasomotor mechanism, excited either by stimulation of brain-tissue or of distant nerves. In passive congestion from heart-disease the treatment is that of the cardiac condition. All persons liable to congestion of the brain should live regularly, avoid hot rooms, and attend carefully to the stomach and bowels, relieving the latter by frequent moderate purgation.

W. R. Gowers.

BRAIN, Hypertrophy of.—Hypertrophy of brain is a misnomer. True hypertrophy would consist of increase in number or in size of the nerve-cells, nerve-tubes, connective stroma, and supplying vessels: and there might be expected, as a result of this condition, some manifestation of a higher intellectual development. Such a condition is never found. A so-called hypertrophied brain is one that is larger and heavier than normal. On removing the skull-cap, the encephalon seems to expand, so as to render it difficult to affix the bone-covering in its place; the membranes are dry, the sulci have nearly disappeared, and the whole organ appears pale and bloodless. On section there is a sensation of toughness, though less in degree than in a case of general sclerosis. There is no sign of pressure upon the orbital plates, such as is met with in chronic hydrocephalus. The lesion affects only the cerebral hemispheres, especially on the convex surface, and perhaps the posterior lobes in particular. The base of the brain and the cerebellum are unaffected except by pressure.

On minute examination, the nerve-cells and nerve-fibres, far from being found augmented in number or in size, may even be compressed and diminished; and there is often also some interference with the normal calibre of the vessels. Gintrac, however, records a case in which the calibre of the nerve-tubes was almost double that of the normal. What increase there is affects the white matter of the brain, and this structure is very pale and of an elastic consistence. The real and sole lesion is hyperplasia of the connective tissue. It differs from sclerosis in affecting the cerebral hemispheres more universally than is the case with sclerosis; and also that in sclerosis there is not only increase of the connective tissue, but subsequent retraction, and, as a frequent consequence of this, an absolute destruction more or less of the nerve-elements of the organ. When the disease is far advanced it may possibly cause absorption of the inner table of the skull, and thus produce a roughness or thinning of the bone, or, in extreme cases, even perforation. The sinuses are generally distended with blood. Hypertrophy of smaller portions of the brain is rare: still various cases are on record in which, under the name of neuromata of the nervous centres, white or grey matter has been found in certain parts of the brain over and above the normal constituents of this organ. Hyperplasia of the pineal gland is closely allied to glioma. It should be distinguished from encysted dropsy of that organ.

Ætiology.—Hypertrophy of the brain has been

said to be sometimes secondary, and caused by the irritation of morbid growths. This, however, is rare. It is generally primary, and may be a disease of intra-uterine life; but it is generally developed after birth, especially in rickety children. Some forms of encephalocele, without hydrocephalus, seem to be due to the growth of compact masses of cerebral substance in excess of what is normal. The conditions for the production of this morbid state are infancy; bad diet; repeated congestion of the cerebral vessels, such as might be induced by frequent cough; and, perhaps, lead-poisoning.

Symptoms.—The symptoms of so-called general hypertrophy vary according as the sutures are closed or not. If, from insufficient occlusion of the sutures, the head expands in proportion to the increase in size of the encephalon, the symptoms may be very slight. Children thus affected show no intellectual hebetude. In them, as long as the abnormality is uncomplicated with local inflammation of membranes or with hæmorrhages, there may be no headache, no affection of sight, no sensory or motor paralysis, and no convulsions. Convulsions, however, are common in cases in which the occlusion of the sutures has prevented expansion of the head proportionate to the internal increase of tissue. In such cases also there is generally more or less motor paralysis, often some anæsthesia of the limbs, headache, vomiting, and mental hebetude—symptoms, in fact, either of marked interference with the intra-cranial circulation, or of irritation from inflammatory complications. The prognosis is always bad, but in rachitic cases the course may be chronic.

Treatment.—All treatment seems to be ineffective in diminishing cerebral hypertrophy.

E. Long Fox.

BRAIN, Inflammation of.—Synon.: Encephalitis.—Encephalitis is a term which ought perhaps to be strictly limited to inflammatory changes in the brain-substance itself, to the exclusion of all forms of meningitis. It may be either *diffuse* or *local*, but for our present purpose we have chiefly to do with the diffuse form. Local encephalitis will generally result in abscess (*see* Brain, Abscess of) and will usually be met with, if we put aside the results of injuries, in association either with disease of the ear, with tubercular growths, or with pyæmic deposits.

It may perhaps be doubted whether the occurrence of diffuse inflammation of the brain-substance as an acute disease has as yet been proved, excepting as a result of wounds. Even as a traumatic lesion, its special features have by no means been accurately studied. It is, however, highly probable that after penetrating wounds of the brain, its substance may inflame, just as the cellular tissue of a limb may, the inflammatory processes beginning at the site of the wound and rapidly spreading through a large part of the hemisphere. It is probably in the perivascular spaces that the process chiefly spreads, and it is in these that the microscope will detect the most abundant results. Such a condition of diffuse encephalitis may exist without there being any visible changes in the brain. It may perhaps be a little softened or a little congested, but very probably there is nothing about which the most experienced pathologist could feel certain until the microscope is resorted to.

Symptoms.—It is not possible, in the present state of our knowledge, to speak with any certainty of the symptoms of diffuse encephalitis. They will vary, of course, with the region affected; and disturbance of function, followed by more or less complete loss, will be the most frequent occurrences.

Treatment.—When the symptoms of encephalitis are once recognised, it will usually be too late for treatment, and measures of prevention are those of chief importance. The early use of mercury, beginning in anticipation of, rather than waiting for symptoms, is probably the most important; and next to it come cold to the head, purgatives, and counter-irritation.

Jonathan Hutchinson.

BRAIN, Laceration of.—In the more strict sense of the word, the brain is but little liable to laceration from injury. Yet, in connection with injuries, such as penetrating wounds of the skull, fractures with great depression of bone, and even with violent concussions, the brain-substance is not unfrequently, to some extent, torn. In so soft a structure, however, and under the influence of modes of violence which are usually rather of the nature of blows than of anything likely to cause stretching, we rarely meet with results comparable to laceration of any of the firmer textures of the body. Whenever the brain is 'lacerated' it is also contused, and the contusion often extends widely around the rent, and is by far the more important lesion. In the peripheral parts of the brain-mass this is especially true, and it is of little practical use to speak of lacerations excepting as complications of very severe contusions. In the central parts, the crura especially, we meet now and then with a laceration properly so called, and it is not very infrequent to find the trunks of single nerves torn across. The consideration of those forms of laceration which are produced by the effusion of blood from ruptured vessels of size sufficient to supply a stream forcible enough to break up the surrounding substance, will be found in the articles Apoplexy, Cerebral; and Brain, Hæmorrhage into.

In the case of injuries to the head from falls or blows without perforation, certain definite parts are prone to suffer from contusion and laceration. Usually some slight evidence of injury is found immediately beneath the part of the skull upon which the blow was received, but by far the chief bruising will be at the opposite point. If the occiput be struck, the anterior lobes will be contused; and if one parietal eminence, the opposite sphenoidal lobe. This law, however, is greatly modified by the differing conditions under which different parts of the brain-mass are placed as regards their surroundings. In the posterior half of the skull the brain-mass is bulky, and between its hinder lobes and the cerebellum is a strong flexible membrane, well calculated to break vibrations gradually, and thus to prevent contusion. Nor are there in these regions

any strongly marked bony ridges against which the brain might be dashed. These conditions are reversed as regards the anterior lobes and the middle lobes, and the consequence is that whilst severe contusions are often seen in the latter, they are much more rare in the cerebellum and posterior two-thirds of the brain-mass. In cases of compound fracture, with tearing of the dura mater, and deep depression of bone, the brain-substance may, of course, be injured at any part; but even in respect to this kind of violence the hinder regions of the skull are specially protected.

Symptoms.—We know enough of surface-lacerations of the brain in parts other than the anterior and middle lobes, to be able to assert that, unless the lesion extend very widely or deeply, it does not reveal itself by any special symptoms. If very extensive, weakness of the opposite limbs and side of the face is usually observed. Injury to the anterior lobes, unless extensive, cannot be diagnosed, but it may be guessed at in a few cases where the sense of smell is lost in one or both nostrils; for it is very common for the olfactory bulbs to be damaged at the same time. If the anterior lobes are severely lacerated, the symptoms will be those of very severe concussion, with the difference that the insensibility is more nearly complete, and that it increases instead of diminishing as the days pass on. When a sphenoidal lobe is contused there is usually, according to the writer's observation, incomplete hemiplegia of the opposite side, involving sensation as well as motion, and the face as well as the limbs. From these symptoms the patient may, in the course of months, wholly recover. It is usually the apex of the sphenoidal lobe which is lacerated, but if the lesion extends higher, and if it occur on the left side, aphasia may be present.

In connexion with recent discoveries (Dr. Hughlings Jackson, Dr. Ferrier, and others) as to localised functions, no doubt we shall be able before long to diagnose more accurately as to the precise regions injured. It would, however, as yet be premature to attempt to do so.

Treatment, and Prognosis.—In the treatment and prognosis of lacerations and contusions of the surface of the brain, much depends upon whether or not the case is complicated by compound fracture and the admission of air. If air have been admitted there is risk of meningitis or encephalitis, denoted in either case by the occurrence, within a few days of the injury, of hemiplegia of the opposite side. To prevent this must be the object of treatment. The scalp should be shaved, the wound closed with sutures as far as practicable, and lint wetted in a spirit-and-lead lotion should be laid over the part and systematically re-wetted every hour. If the case be treated in hospital it may be well, in addition to this, to wash the wound with the lotion before closing it, or to dress with Lister's antiseptic precautions. In cases of laceration without access of air death may ensue from diffuse softening around the part. If this happens the case will probably end within a week or ten days. It is probable that many cases of fractured base with more or less severe laceration of brain recover; in some with permanent paralysis, but in others without. It must be added that many of the cases in which death occurs within a few hours or a day or two after fracture of the base are attended by laceration. In these the symptoms are often difficult to distinguish from those of compression. Profound insensibility, a bloated face, stertorous breathing, and a full pulse, are often present; but they may be substituted by pallor and a feeble pulse in connection with great depression of the heart's action. If any deviation from symmetry as regards the paralysis of the limbs can be proved, it is in favour of laceration and against compression, but the differential diagnosis is a matter of extreme difficulty.

Laceration of Cranial Nerves.—Lacerations of single nerves within the cranial cavity are not by any means uncommon. This occurrence is to be suspected whenever the parts supplied by a cranial nerve are completely paralysed, without accompanying symptoms indicative of severe lesion of the brain-mass. Cases of laceration of the brain itself may be complicated by laceration of nerve-trunks, and thus the symptoms may become difficult to interpret with confidence.

Of single cranial nerves the olfactory bulbs are the most liable to suffer from contusion; and the third, fourth, and sixth nerve-trunks are those most frequently torn through.

Jonathan Hutchinson.

BRAIN, Malformations of.—The malformations of the cranium and its contents may be divided into two series:—A. Those which are scarcely compatible with life; and B. Those in which life is possible, although the intellectual power may be more or less modified from a healthy condition.

A. The *first* series will include at least seven forms, in all of which life is so rare that it is impossible to speak of more than the pathological anatomy.

1. *Dicephalia*—in which two heads are found upon a single body, or upon two bodies pretty extensively connected. In the first variety, one head may be attached to the vault of the palate of the other, or may be united to the convexity of the skull. In the second variety the heads may sometimes spring from a single neck. This dicephalous condition is frequently accompanied by malformation affecting the spinal column and spinal nerves, as well as by some incompleteness in the development of the brain.

2. *Monocephalia*—the union of two heads into one, on two separate bodies. The two cranial cavities are united into one. Dissection of the dura mater points to this membrane having been formed out of two, and in like manner the cranial contents are either double, or appear to be single from the union of double organs.

3. *Acephalia*—the complete absence of head. An acephalous monster is usually a twin; and when this is not the case, it is associated with the morbid condition of the uterus of the mother known by the name of uterine hydatids.

4. *Paracephalia*—the head not entirely wanting, but deprived of most of the cranium and of the face. A monster of this kind is generally a twin.

5. *Anencephalia*.—The absolute meaning of this term would be the absence of all cranial contents, but it is made to include certain varie-

ties, differing according to the amount of the encephalon developed. The aspect of the head, resembling that of a frog, the considerable projection of the eyes, the flattening of the forehead, and the absence of the cranial vault, are the chief characteristics of this abnormality.

In the first degree, there is absence of cerebrum, cerebellum, mesocephale, and spinal cord. In cases of this kind the cranial vault is generally absent, and the bones at the base of the skull convex and thickened.

In the second degree, the cerebrum, cerebellum, and mesocephale are absent, but a portion of the spinal cord is found. This portion of cord is most usually the lower part.

In the third degree, the spinal cord is pretty complete, but there is still an absence of the cerebrum, cerebellum, and mesocephale.

A few cases have been recorded of the fourth degree, in which no cerebrum or cerebellum are found, but a normal spinal cord, and a pretty complete mesocephale.

In the fifth degree, the cerebrum alone is entirely or almost entirely absent, whilst the rest of the nervous centres are present, though not always in a perfectly complete condition. The seat of the absent cerebrum is often filled by fluid.

Lastly, one case has been recorded in which the cerebrum was present, whilst the cerebellum, mesocephale, and spinal cord were wanting.

Anencephalia, like the other previously mentioned malformations, is due to arrest of development, such arrest depending either on physical injuries to the uterus at a very early period of pregnancy, or to some mental shock experienced by the mother during the first two months after conception. It differs from acephalia, not only by the partial formation of the head, but by the presence of the heart, and other thoracic organs. The ganglia of the sympathetic are usually well-developed.

6. *Pseudencephalia.* In this malformation there is anencephalia *plus* a very considerable thickening of the meninges, which take the place and often imitate the aspect of the brain. Its varieties exactly correspond to those of anencephalia. The tumour formed by the development of the membranes is of variable size and position. It may be frontal, fronto-parietal, or occipital. The real seat of the lesion is the pia mater. The abnormality consists in extreme hypertrophy of this structure, with complete arrest in the development of the encephalon, or of some portion of it. Several observers have recognised certain vesicles in the interior of the membranous tumour, and these have been supposed to be cerebral cells in process of development. It is more in accordance with observation to believe with Gintrac that they are connected with the development of the choroid plexus.

7. *Cyclocephalia.* In this monstrosity there is an approximation or actual fusion of two eyes in a common orbit. It is connected with certain abnormalities in the brain, that militate against viability, or at least prolongation of life. The brain itself is generally more or less deficient, especially in its anterior and central portions, and in some cases the nose and mouth are very ill-developed.

B. The *second series* of cases owe their abnormal conditions to injury arising in the course of fœtal life; and some forms at least may be due to lesion occurring at a later period than in the first series.

8. *Atelencephalia*—incompleteness of brain or of membranes—is the chief of these forms. This incompleteness manifests itself in seven varieties, according to the part of the encephelon injured by the lesion.

In the first variety, the dura mater is somewhat deficient, being altogether absent in certain situations at the base of the brain. The falx cerebri may be wanting, or from incomplete development it may seem perforated with holes; or the tentorium cerebelli may be absent. There are no symptoms which allow a positive diagnosis of any of these lesions during life.

In the second variety, there is general incompleteness of the brain, or imperfection of several portions of it at one and the same time. Whilst the cranial vault is thrown back, and the lower jaw is short, the base of the skull is large, the cerebral convolutions almost absent, and the cerebellum large. The head is almost always small, and it may present various irregular forms. This coincides with certain internal lesions, partial or general atrophy with consequent serous effusion under the membranes, inflammatory conditions, or thickening of the cranial bones and of the meninges. The incompleteness of the brain varies exceedingly, from a condition in which the whole brain is atrophied, to spots of deficiency, such as the absence of a single convolution, of the septum, or of the pineal gland. The symptoms will necessarily vary much according to the amount of cerebral incompleteness. Where this is general, affecting in some degree all the convolutions, the intellectual powers, as in the microcephalous Aztecs, will be very slightly developed, and their language of the very simplest form. With the brain still more imperfect, there is generally complete idiocy or a condition closely allied to it. The special senses are dulled, particularly sight and hearing. Speech is in abeyance, or is limited to monosyllables. There are various motor phenomena, such as muscular debility, hemiplegia, paraplegia, contraction, convulsion, loss of power over sphincters, dysphagia, vomiting, or feebleness of respiration.

The third variety includes incompleteness of the central parts of the brain. The corpus callosum, the septum, the fornix, the corpora striata, and the cornua ammonis may be imperfectly developed. The cerebral hemispheres may thus be in some sort fused together, and the shape of the ventricles altered. The symptoms differ from those of the preceding variety, in that the special senses are seldom involved; and that, although complete idiocy may accompany these lesions, it is more usual for the brain to be found capable of some slight intelligence, though unequal to the conception of abstract ideas.

In the fourth variety, the lateral portions of the brain are incomplete. This lesion generally occupies one side of the brain, leaving the other hemisphere intact. Several points in the hemisphere may be affected, or the whole of a single lobe. Most usually there is a depression occupying the seat of one or more convolutions. Such

a lesion occasionally attacks the whole hemisphere, giving it the appearance of a large pouch filled with fluid. Sometimes also the neighbouring ventricle communicates with it; or there may be much ventricular effusion, with imperfect development of the corpus striatum, the optic thalamus, the cornua ammonis, the mamillary tubercle, the crus cerebri, and the optic and olfactory nerves of one side. In a considerable proportion of patients so affected, the lesion is accompanied by idiocy, and possibly the inability to speak is connected with this mental condition. Some few patients, however, possessed with some intelligence, have yet been unable to speak; this has been the case even when the lesion has existed on the right side. Deafness is rare; feebleness of sight, various forms of strabismus, and nystagmus common. Very frequently there is hemiplegia of the side opposite to the lesion, and certain other affections of the limbs,—emaciation, incomplete development, contraction, various deformities of the hands, &c. Sensation even in the paralysed limbs is normal; convulsions are not uncommon.

In the fifth variety, there is incompleteness of the anterior portion of the brain. Here both the anterior lobes are affected together. This condition may be associated with some deficiency of the corpus callosum, fornix, and corpora striata. Idiocy is not uncommon; mutism is the rule, but in some patients not idiotic a few words have been possible. Other phenomena—amaurosis, strabismus, and various motor abnormalities—have occurred so irregularly in these patients that it is probable they were symptoms not so much of this lesion as of certain further complications.

Incompleteness of the cerebellum forms the sixth variety. This is sometimes associated with a similar condition of one side of the brain. Usually one lateral lobe only is affected. General hydrocephalus is an occasional complication, and a collection of fluid under the tentorium cerebelli is very common. The symptoms are very negative. In general terms it may be said that there is no loss of muscular co-ordination, and no loss of sexual power.

In the seventh variety, there is incompleteness of the mesocephale and medulla oblongata. This is not carried very far. Certain modifications in form and volume are alone compatible with the preservation of life. It is not a common lesion, and has generally been associated with idiocy.

9. *Congenital hydrocephalus.* One variety of this congenital effusion of fluid is rare, viz., when the fluid is outside the dura mater, between this membrane and the pericranium, and the cranial bones are found floating in the midst of the fluid.

The second variety is that in which the fluid lies outside the brain. The writer believes that serous effusion in this position is not the cause of the atrophy, flattening, or induration of the subjacent cerebral organs, but the effect; that where fluid is found in this situation it is only the consequence of some one of the lesions already mentioned, notably atrophy of brain from whatever cause, and of atelencephalia. This view is, however, opposed to that of some authors.

The third variety is congenital hydrocephalus of the ventricles. In some such cases the increase in the size of the head occurs before birth; in others, not until after. The head increases rapidly in size in the first four weeks after birth. The sutures are widely separated, the cranial bones very thin, the integuments of the head injected, and the hair deficient. The muscles are badly developed, locomotion is imperfect, the intellect is generally obtuse, but the special senses are not particularly affected, unless it be that sight is deficient.

10. *Synencephalia* is merely a matter of pathological interest. The head of the fœtus is sometimes found adherent to the membranes or to the placenta, as a consequence of intra-uterine inflammation. At the point of adhesion the place of the cranial bone is taken by a thin vascular membrane. This condition is sometimes accompanied by, and indeed perhaps causes, encephalocele.

11. *Exencephalia.*—Here a large portion of the brain is situated outside the cavity of the cranium. Practically it includes all the other malformations of the brain that are yet to be spoken of. Thus, if only a limited portion of the brain finds its way outside the skull by an abnormal opening, the displacement is known by the name of *encephalocele*, or *hernia cerebri*; if this hernia coincide with a hydrocephalic condition of the ventricles, it is called *hydrencephalocele*; and if the hernia is composed not of the brain, but of the membranes, distended with fluid it may be, the lesion is called *meningocele* or *hydromeningocele*. Exencephalia proper may be subdivided into *frontal*, *sincipital*, and *occipital*, according to the direction taken by the extruded brain.

In encephalocele only a portion of the brain more or less limited is found outside the skull. The exit takes place most frequently at the occipital, and next in the frontal region; but the temporal and parietal regions are occasionally the seat of this lesion. The symptoms may be very negative. Encephalocele unless pressed upon externally is not often attended by convulsion or paralysis, by intellectual feebleness, or by difficulty of speech. This latter symptom is sometimes found when the hernia includes the cerebellum. Neither is this lesion incompatible with the prolongation of life. The chief diagnostic difficulty is the possibility of the tumour being cephalhæmatoma, but this is frequently situated over the parietal bones, an unusual position for encephalocele: and external pressure of the former tumour causes none of the cerebral phenomena—stupor, dilatation of pupils, paralysis, convulsion, so constantly seen from compression of an encephalocele. E. Long Fox.

BRAIN, Malignant Diseases of. *See* Brain, Tumours and New Growths of.

BRAIN, Membranes or Meninges of.—*See* Meninges, Diseases of.

BRAIN, Morbid Growths of. *See* Brain, Tumours and New Growths of.

BRAIN, Œdema of.—Definition.—Infiltration of the brain and pia mater with serum.

Ætiology and Pathology.—In chronic maladies attended with general œdema, especially Bright's disease, fluid is effused around the

brain, into the meshes of the pia mater and between the convolutions. Occasionally the cerebral substance is infiltrated, but this is uncommon. The perivascular canals afford a ready means of escape for effused serum, and in Bright's disease, at least, the substance of the brain often contrasts, by its firmness, with the condition of other organs. In senile atrophy of the brain the space between the shrunken convolutions is occupied by serum, and the ventricles contain an excess of fluid. The brain-tissue may appear to contain more fluid than usual in consequence of the distension by serum of the enlarged perivascular canals. In hyperæmia, especially passive, such as occurs in heart-disease, serum is commonly effused from the engorged vessels. Such effusion is also common in insanity, especially in acute dementia. The serum may infiltrate the pia mater, distend the perivascular canals, and even infiltrate the brain-tissue.

The effusion of fluid in these cases is usually slight. Occasionally it is more considerable, and the cerebral substance may be enlarged, the convolutions being flattened, and the tissue much lessened in consistence. The same softening is seen in the neighbourhood of effusions of fluid into the ventricles; the brain-tissue for a depth of some lines from the ependyma being softened to a pulpy consistence. The post-mortem imbibition always increases the apparent amount of the œdema.

Symptoms.—Little is known of the symptoms of œdema of the brain. The œdema is usually secondary to some other condition, the symptoms of which mask those of the œdema. General œdema seems attended by slow diminution of mental power and motor force. The effusion of serum in cases of congestion, and consequent pressure on the nerve-elements, has been considered as the cause of the symptoms of depression common in that condition. Cases occasionally occur in which effusion of serum into the ventricles and the pia mater is the only post-mortem condition to be found after an apoplectiform seizure, and such cases are often spoken of as instances of *serous apoplexy*. In so far as the effusion of serum is related to the apoplectic attack, it is probably merely as the consequence of a cerebral congestion which has left no recognisable post-mortem hyperæmia.

Treatment. — The treatment of cerebral œdema is usually secondary to the condition, commonly conspicuous enough, which is its cause,—Bright's disease, passive cerebral congestion, &c. If œdema be suspected where no causal indication for treatment exists, purgatives and diuretics, with iron if there be debility, are the remedies most likely to be of service.

The effusion of fluid into the ventricles is described under Hydrocephalus.

W. R. Gowers.

BRAIN, Sclerosis of. *See* Spinal Cord, Diseases of.

BRAIN, Softening of.—Definition.—A pathological state of brain-tissue, depending commonly on vascular obstruction; attended by diminished consistence, usually local; and indicated, during life, by mental, motor, and sensory symptoms, which vary according to the seat of the lesion.

Ætiology.—Local softening of the brain, occurring during life, is due to one of two causes, inflammation or vascular obstruction. Most cases were formerly thought to be due to inflammation; but it is now known that very few are. The vascular obstruction, which is the usual cause of softening, may be arterial or, rarely, capillary; it may be due to a coagulum formed *in situ* (thrombosis), or to a plug of fibrin conveyed into the vessels by the blood (embolism). The predisposing and exciting causes of these conditions will therefore be those of softening of the brain (*see* Brain, Vessels of, Diseases of). The chief concomitant conditions are—in thrombosis, vascular degeneration; in embolism, valvular disease of the heart: and as predisposing conditions we usually find, in cases of thrombosis, advanced age, Bright's disease, chronic alcoholism, or syphilis; in cases of embolism, acute rheumatism, chorea, or scarlet fever. Senile vascular degeneration is the most common cause of all of softening of the brain, and hence the disease is met with most frequently in the old, especially in its recurrent and chronic form. Embolism, due to valvular disease of the heart, and thrombosis due to syphilitic disease, are the most frequent causes of acute local softening in the young and middle-aged.

Anatomical Characters.—The characteristic feature of cerebral softening is diminished consistence. This may, however, arise from ante mortem or post-mortem changes. In each case the diminished consistence depends on the breaking-up of the myelin, of which the nerve-fibres are composed, into globules and granules, and the separation of these by an increased quantity of fluid. Thus the continuous structures of which the brain consists are broken up into disconnected fragments, and the consistence of the tissue is accordingly diminished. In *post-mortem* softening there is nothing more. The globules of myelin are often large, and the separating fluid abundant. The softened tissue has the tint of the normal cerebral substance. The process is the result of the imbibition of fluid from some collection of serum, in the ventricles or elsewhere, and occurs in the greater degree in the immediate vicinity of this. In *ante-mortem* softening there are, in addition, certain changes in the tissue-elements. The process of segmentation of myelin results in the formation of finer granules. These are in part aggregated into 'granule corpuscles,' round or oval masses of globules and granules, sometimes contained within a distinct cell-wall. Some of these bodies may arise by simple aggregation, many certainly by the degeneration and distension of connective-tissue cells, and some by the degeneration of nerve cells. The walls of vessels in the softened area also present fatty degeneration. The specific gravity of the tissue is diminished (Bastian). No further change may exist, and the area affected may present simply a diminution of consistence, its colour remaining unchanged. It is then called *white* or *grey softening*. Very frequently, however, in the part thus diseased, distension of capillaries with

blood occurs, most considerable in the periphery, and blood is actually effused, chiefly by rupture of capillaries, in part perhaps by migration of corpuscles. In proportion to the amount of blood extravasated, the colour is changed, and thus *red softening* is produced. After a time, the effused blood degenerates, its tint becomes altered to yellow or orange, and *yellow softening* is produced. Ultimately, it is said, the colour, if at first moderate, may be removed, and white softening result.

Red softening is found chiefly in the grey substance, where the vessels are numerous, especially in the cortex and central ganglia. The tint varies; the red colour is usually punctiform, or mingled with yellow and white. If the extravasations are large and numerous, 'capillary apoplexy' results. The diminution of consistence is usually moderate. According to the amount of effusion of serum and blood there is swelling, and the diseased area may project above the cut surface. Inflammatory changes result from the vascular distension, and in proportion to these, increase in the nuclei of the neuroglia is found. From this cause and from the migration of white corpuscles, pus-like cells appear. The vessels are dilated, and may present a moniliform appearance. Their perivascular sheaths are often distended with blood. Commencing degeneration of the effused blood may cause a brown tint.

Yellow softening results from red softening, by degenerative changes in the blood effused. It has a similar seat, being frequently met with in the convolutions, where it constitutes *plaques jaunes* of the French. Its consistence is usually slight, its aspect granular. The colour depends on the presence of minute pigment granules, diffused colouring matter, and hæmatoidin crystals.

White softening has the tint of the normal cerebral substance. In consistence it varies; it may be only a little below that of the cerebral substance, or it may be diffluent. Its aspect is uniform, or white flakes are scattered through it. The limits are usually gradual. Under the microscope it presents the detritus of nerve-elements, a few nuclei from the connective tissue, granule-corpuscles, and, ultimately, corpora amylacea. White softening is chiefly found in the white substance of the hemispheres. It occasionally has a gangrenous odour, and then may be found in the white or in the grey substance, probably resulting from the obstruction of capillaries by septic material.

Ultimate changes.—White and yellow softening may remain for years unchanged. Sometimes the changes in the elements of the neuroglia and the extravasated white corpuscles result in the formation of a considerable quantity of connective tissue, consisting of fine fibre-cells and fibres, most abundant in the margins of the softened area, which become firm and dense, while trabeculæ of connective tissue cross the cavity. After a time the fluid may be absorbed, the fat removed, and a sort of cicatrix result. In other cases the walls alone are thus altered, the solid particles are removed from the softened tissue, and a cyst is formed. The outer portion of the cyst or cicatrix may be limited by a zone of dilated blood-vessels.

Seats of softening.—There is no part of the brain in which softening has not been found, but its most frequent seats are the cortex, the corpus striatum, and the optic thalamus. In the cerebellum, pons Varolii, and medulla it is also frequently found. Its occurrence, position, and characters depend on the distribution of the vessels. The small arteries of the corpus striatum and optic thalamus are 'terminal arteries,' having only capillary communication with other vessels. The arteries to the surface of the brain are usually for the most part terminal, but sometimes possess arteriole-anastomoses with other branches. Hence obstruction in the central arteries leads invariably to softening. Obstruction in the superficial arteries also usually causes softening, which involves the grey substance of the convolutions and some of the subjacent white centre to which the vessels penetrate; but occasionally the anastomoses of the superficial vessels are so free that softening does not result. An obstruction of a main trunk (as the middle cerebral) may lead to softening of the central region (corpus striatum), while the convolutions escape; but usually both suffer.

Symptoms.—The *premonitory* symptoms of softening depend upon its cause. In embolism other symptoms than those of the cardiac trouble are usually absent. Occasionally a slight attack of loss of cerebral function, due to a slight embolism, may precede a graver attack. In softening due to arterial disease, premonitory symptoms of local cerebral anæmia are frequently present. There is defective nutrition of many parts of the brain, revealing itself by symptoms of wide range—mental deterioration, numbness, pains in the limbs, pain in the head, or slight local weakness. These symptoms are of especial significance when associated with evidence of arterial degeneration elsewhere; with the conditions—as chronic Bright's disease, alcoholism, and senility—in which atheroma of the cerebral arteries is common; or with constitutional syphilis.

The symptoms of *actual* softening are those of loss of function in the damaged portion of the brain. The onset of the symptoms may be sudden, as in embolism, and sometimes in thrombrosis; or it may be gradual, as occasionally in thrombosis. In the former case the symptoms of initial shock are added to those proper to the locality. The latter are fully considered in the articles on Localisation. Hemiplegic symptoms and mental alteration are the most common. Hemiplegia especially occurs in embolism, on account of the frequency with which the middle cerebral artery is obstructed, and of the important motor regions (corpus striatum and motor parts of the convolutions) to which that artery is distributed. From the distribution of the artery to the lower frontal convolutions and adjacent region, aphasia is frequently present when the obstruction is on the left side.

When the symptoms come on suddenly, they often follow some exertion, or occur during exhaustion. If the area damaged be extensive, there is loss of consciousness, and there may be all the symptoms of an apoplectic seizure. The loss of consciousness is rarely profound, and the symptoms of apoplexy soon pass off. In the most

severe cases, however, they may deepen to fatal coma. Symptoms of irritation commonly succeed those of apoplexy as the collateral hyperæmia sets in, or they may be marked at the onset. Convulsions, often unilateral, may occur and be repeated for days. The patient may pass from the apoplectic condition into one of delirium. In the old, delirium may be the chief symptom of the onset. According as these symptoms are chiefly marked at the onset three varieties have been described, the *apoplectic*, *convulsive*, or *delirious* forms.

Recovery from the special symptoms of the attack is often incomplete; permanent weakness may remain, as hemiplegia, and mental power is weakened, the patient passing into the chronic state about to be described. The persistent hemiplegia is often accompanied by rigidity, or by motile spasm, such as, in its most marked form, has been described as *athetosis*. Whether recovery is complete or incomplete, return or relapse is common, and is almost invariable where the arterial disease, to which the softening is due, is widely spread.

Chronic softening is a term applied to a group of symptoms, of wide range, indicative of failure of brain-power. These may supervene on more acute symptoms of softening, or may be gradual in their onset. There is mental dulness, defective perception, drowsiness, loss of memory (especially for recent events), often slight wandering; emotional manifestations are easily excited. The patient complains of headache, pains in the limbs, and feelings of 'numbness,' which may or may not be associated with actual loss of sensibility. Physical power is defective, usually generally, sometimes locally. The more delicate motor actions are imperfectly adjusted: articulation becomes confluent, and the handwriting indistinct or illegible. These symptoms may progress into actual imbecility, or may be cut short by some more profound cerebral seizure, or by some intercurrent pulmonary affection, rendered grave by the deficient muscular respiratory power. They depend upon degeneration of brain, commonly due to arterial disease. Spots of softening, often widely spread, may be associated with this condition, and may be, indeed, the cause of the symptoms. But the state may come on without any local softening; and atrophy of brain, with or even without degenerated vessels, may be the only anatomical condition. It often follows any grave local lesion—softening, hæmorrhage, or tumour—and then depends on a direct prejudicial influence on the cerebral nutrition, or on a secondary effect through the perturbed vascular system.

Diagnosis.—The *acute* form of softening has to be distinguished from acute congestive apoplexy and from cerebral hæmorrhage. It is distinguished from the former by the persistence of the symptoms indicative of local mischief, and by the absence of evidence of cephalic hyperæmia. From hæmorrhage the diagnosis is often difficult. In softening from thrombosis, the initial apoplectic symptoms may be absent, or, if present, are slight and brief. They are more often preceded by symptoms of local cerebral anæmia, due to the vascular disease, than is the onset of cerebral hæmorrhage. Improvement occurs earlier than in cerebral hæmorrhage. The temperature rises soon after the attack, but falls in a day or two; in hæmorrhage the rise occurs later (Bourneville). There is more marked mental change than in hæmorrhage, shown at first in excitement, subsequently by depression and deterioration of power. In the cases in which the onset is sudden and the apoplexy profound, a diagnosis from hæmorrhage is often impossible. In softening from embolism the patient is usually below middle age, heart-disease is present, and evidence of arterial disease is absent. The onset of the attack is commonly sudden, but the loss of consciousness is less profound than in hæmorrhage. In capillary embolism, if extensive, a distinction from hæmorrhage often cannot be made: the loss of consciousness is profound and lasting.

Softening may be distinguished from local cerebral anæmia, which often precedes it, by the definiteness and persistence of local symptoms; but a small area of softening may produce symptoms identical with those resulting from a large area of anæmia. Softening is distinguished from tumour and chronic meningitis by the slight pain and the absence of optic neuritis. From simple atrophy of the brain, *chronic* softening differs by its less uniform course, and by the sudden occurrence and persistence of symptoms indicative of local lesions.

Prognosis.—The immediate and ultimate prognosis in an attack of softening of the brain depends on its severity in degree and extent, as indicating the extent of the lesion, and on the region of the brain damaged. Both the immediate and the ultimate prognosis is much graver in damage to the medulla and pons Varolii than when the corpus striatum or cerebral hemispheres are affected. Youth and general health favour the rapidity and the degree of recovery. Where actual softening has occurred, the damaged tissue probably never regains its functional power. The congested periphery recovers in proportion to the inherent vitality of the tissues, and to the freedom of the vessels from disease. The chances of a recurrence of softening in another situation depend on the extent to which its causal condition is widely spread or can be removed. In vascular degeneration recurrence is almost certain. In embolic softening there is usually organic valvular disease in the heart, and embolism recurs in a considerable proportion of the cases, though less frequently than senile thrombosis. The prognosis in syphilitic disease of the vessels depends upon the recognition and treatment of the syphilitic influence.

Treatment.—During an acute attack the patient must be kept at perfect rest, with the head moderately raised, in a uniform temperature. During the initial stage of shock, warmth, by hot-water bottles, &c., should be applied to the surface, to equalize the circulation. The bowels, if confined, should be made to act gently; but, unless the evidences of encephalic congestion are early and conspicuous, purgation should be avoided. Should stimulants be administered? It has been proposed by stimulation of the heart to aid the establishment of the collateral circulation. But it must be remembered that the imper-

fect collateral flow arises from the minute size of the arterial anastomoses. The obstruction of one vessel always increases the adjacent pressure to such an extent as to distend the vessels to their utmost strength, and any further increase would, by rupturing them, impede rather than further the object in view. If, therefore, the heart is acting feebly, stimulate it by small quantities of alcohol to the normal force, but not beyond. If the diagnosis from hæmorrhage be in any degree doubtful, great caution should be observed in stimulation. After the stage of depression has passed, the irritation due to collateral hyperæmia, and indicated by elevation of temperature, may be relieved by purgatives, dry-cupping, and even, in some cases, by the application of leeches, though the latter are only necessary when the evidence of general vascular irritation is great. When convulsion is an early and recurrent symptom, mustard plasters to the neck and extremities, and bromide of potassium in large doses, are useful.

After the attack has passed, recovery must be aided by maintaining the general health in the best possible condition. The secretions should be kept free, the digestive organs in good order, the habits strictly regulated, and nervine tonics, cod-liver oil, hypophosphite of soda, strychnine, quinine, and iron, may be given with advantage. The symptoms of chronic softening, whether occurring after an acute attack or coming on gradually, should be treated in a similar manner. Great care should be taken that the peripheral obstruction to the circulation, indicated by augmented arterial tension, (incompressibility of pulse), is kept at its minimum by the avoidance of excess in diet, and by prompt purgation when any increase in tension is observed.

W. R. Gowers.

BRAIN, Syphilitic Disease of. *See* Brain, Tumours and New Growths of.

BRAIN, Tubercle of. *See* Brain, Tumours and New Growths of.

BRAIN, Tumours and New Growths of.—The intimate connection of the brain with its membranes makes it impossible, except in the most general terms, to draw any marked distinction between tumours of the cerebral substance, and tumours arising from its envelopes. A growth pressing inwards from a membrane must impinge upon brain-tissue: a growth originating in brain-tissue must in many situations involve the membranes.

Anatomical Characters.—The tissues from which tumours have their origin seem to present the best ground for a scientific classification of these lesions: and it is not devoid of interest to mark that the absolute nerve-elements of the brain are never primarily the source of a morbid growth.

Cerebral tumours, then, may be roughly separated into three series:—

1. Those whose centre of origin is some one or other of the membranes, external to the brain, or dipping into the ventricles.

2. Those which spring from the blood-vessels.

3. Those which own the neuroglia as their starting-point.

Taking this subdivision, which is Rindfleisch's, the tumours which are placed in each series differ somewhat from his arrangement.

In the first series five kinds of tumour are found, arising from the membranes or from the free surface of the ventricles. These are Pacchionian granulations; spindle-celled sarcoma; myxoma of the membranes; psammoma; and lipoma.

The second series will include, first, aneurisms, depending upon disease of one or more of the arterial coats; and, secondly, such tumours as have their origin in the sheaths of the vessels, comprising carcinoma cerebri simplex; fungus of the dura mater; cholesteoma; epithelioma myxomatodes psammosum; papilloma of the pia-mater and vessels; papilloma myxomatodes; and tubercle.

In the third series may be counted glioma; myxoma of the nerve-substance; syphilitic gumma; and fibroma.

Included under none of these headings, echinococci and cysticerci cellulosæ must be mentioned, as they affect the brain.

Each of the growths enumerated will now be briefly described.

1. *Pacchionian granulations.* These are granulations of the arachnoid, sometimes met with in childhood, very constantly from middle age onwards, and scarcely recognised as morbid lesions. Their ætiology is unknown. They do not give rise to any symptoms. They are chiefly situated along the superior longitudinal sinus, which in rare cases is perforated by them. They form groups of papillæ, consisting of striped connective tissue, poor in cells, and proceeding directly from a thin but a continually renewed layer of sub-epithelial germinal tissue.

2. *Sarcoma.* This sometimes has its origin in the nervous tissue itself, but more frequently arises from the dura mater, especially at the base of the skull. From their situation sarcomata are especially apt to interfere with one or more of the cerebral nerves. They may attain the size of a pigeon's, or even of a hen's egg.

When sarcoma attacks the dura mater it originates from its internal side. The most usual situation is the membrane about the sella turcica and the pars petrosa. It forms a depression in the brain, while the bone becomes atrophied behind it. The growth is composed of fusiform cells, with tolerably numerous, and sometimes dilated vessels. Sarcomatous growths are not freely developed above the surface, but rather in the depths of the tissue; they distend the cerebral convolutions, form deep depressions on the surface, and even penetrate far into the brain. They occur under two forms—*hard sarcoma* with compact fibrous fundamental tissue and small cells, often called fibrous tumour; and *soft sarcoma*, with a loose scanty intercellular substance, and numerous cells of comparatively large size. The cells are mostly fusiform, but sometimes round and multinuclear, and the two latter may be surrounded by the former. Sarcoma in this situation is generally single. It may attain the size of a nut or even of an apple; and is frequently hæmorrhagic.

In the cerebral tissue itself the hard sarcoma

attains a great degree of density: it is sometimes fibrous, at other times cartilaginous, of a dense homogeneous structure, whitish or bluish-white, with a yellow tinge here and there, and with very few vessels. It is distinguished from the brain that surrounds it by a very vascular zone. It can be easily separated from the parenchyma, and may thus be recognised after death from simple sclerosis and hard glioma of the brain. The softer form—fibro-cellular sarcoma — is generally either a myxo- or a glio-sarcoma: but pure fuso-cellular sarcoma is met with. The tumour is a clear grey, almost like the grey matter of the corpus striatum. It is often vascular, with a reddish tinge. These sarcomata are often almost spherical, and easily detached from the surrounding brain-substance. Others, however, seem to be continuous with the neighbouring tissue, and to be little more than simple hypertrophies of the cerebral tissue. Especially is this the case in tumours of the corpus striatum and optic thalamus. The cells of cerebral sarcoma are frequently the seat of fatty degeneration, and the whole tumour may be hæmorrhagic. Its most frequent situations in the brain are the ganglia at the base.

3. *Myxoma.*—Myxoma of the membranes is rare, and generally has its origin from the convexity of the brain, being connected with the inner surface of the dura mater. It is a small growth, soft, fragile, having a gelatinous aspect.

Myxomata are frequently met with in the cerebral hemispheres, and then take their origin from the neuroglia. Such growths are probably malignant, the proof of their malignancy being that they are often multiple locally; that they frequently recur when removed from a peripheral nerve; and that they not seldom affect internal organs. Myxoma probably includes all that has been called colloid cancer. When this lesion affects the cerebral hemispheres it may be of large size. The mucus is a constituent part of the tissue; it is not a product of secretion, as in mucous cysts.

4. *Psammoma.*—Psammomata have been met with in the brain, spinal membranes, spinal cord, and nerves: they are not uncommon in the choroid plexus, but are most usually found in the pineal gland. There are two kinds of these growths. In the first, the sand occupies the interior of the meshes of the connective tissue in very varied forms, as compact cylinders, as pear-shaped masses, as spines, or as globes, surrounded by connective tissue, and connected by it with the other parts of the tumour. In the second form, the sand lies without cohesion in the parts and between them, so that the different grains of sand may be easily isolated. In this latter form, the psammoma is composed most generally of round elliptical corpuscles, and sometimes also of large complex conglomerations. These little tumours have usually an internal concentric arrangement.

5. *Lipoma.*—This is a rare form of tumour. It may be connected with the inner surface of the dura mater, or with the ependyma of the ventricles. The fatty matter is contained in cells, and the cells are surrounded by an organised membrane. Lipoma is usually single, seldom multiple; of irregular shape; and varies in size from a small nut to a hen's egg. Small pieces of carbonate of lime have been found in these tumours.

6. *Aneurisms.*—The larger cerebral aneurisms have been observed from early times. More recently Liouville has called special attention to the subject of miliary aneurisms, and has shown that they are common; that they are multiple; that they frequently give way in the brain or in the pia mater; and that they often co-exist with aneurisms of the larger vessels in other parts of the body. Aneurism of the middle meningeal, of the internal carotid within the cavernous sinus and at its exit from it, of the anterior cerebral, of the anterior communicating, of the arteries of the corpus callosum, of the middle cerebral, of the posterior communicating, of the vertebral, of the basilar, of the posterior cerebral, and of the arteries supplying the cerebellum, are all met with not unfrequently. The middle cerebral and the basilar, however, are the vessels most usually affected with this lesion.

The minute miliary aneurisms have been observed in the pia mater, at the surface of the convolutions or in their substance, in the optic thalami, the pons, the corpora striata, cerebellum, crura cerebri, and medulla oblongata; more rarely in the centrum ovale. These miliary aneurisms may be visible to the naked eye. The smallest are seen under the microscope as ampullæ of the vessels, containing coagulated blood or granules of hematoidin. The arterial walls have generally undergone some form of degeneration. The vessel, dilated at some parts, is constricted at others. The lesion may be a consequence of atheroma of the vessel, but far more commonly it is the result of arterio-sclerosis of the inner coat of the vessels, either at the seat or in the immediate neighbourhood of the aneurism. *See* BRAIN, Vessels of, Diseases of.

7. *Carcinoma cerebri simplex.* Cancer, excluding from this term sarcoma and glioma, may originate in the cranial bones, the dura mater, the pia mater, the cerebrum, the cerebellum, the pons, and the medulla oblongata. The medulla oblongata, the fornix, and the corpora quadrigemina, are the regions least often affected, whereas the cerebral hemispheres are the most favourite localities. All forms of cancer are met with, in all cases having their origin in the coats of the vessels. Epithelial cancer has been generally believed to have its starting point in the peripheral layer of the arachnoid, the tissue that lines the under surface of the dura mater. Encephaloid cancer is, however, the most common form met with in the brain.

8. *Fungus of the dura mater* can scarcely be separated from the preceding form. It arises from the outer surface of the dura mater, penetrates with the vessel from which it springs into the compact tissue, destroys the vitreous table, and spreads out in the diploë: in its progress it may penetrate the external table and lift up the integuments of the cranium. The internal table invariably suffers more than the external. Sometimes there is coincident passage of the tumour inwards, and the subjacent membranes become glued to the dura mater and to the cerebral substance. There may result simply

the depression of surface consequent upon pressure from above, but more commonly cell-growth similar to that of the original tumour takes place, first from the vessels of the pia mater, and afterwards from the vessels of the cerebral convolutions.

9. Closely allied to the epithelial cancer that has its origin in the dura mater is the *cholesteoma*, which is generally situated at the base of the brain. Rindfleisch considers it a squamous epithelioma, whose cellular cylinders are wholly converted into a mass of pearly nodules with a silky lustre. It is covered by the arachnoid, and springs either from the vessels of the pia mater, or more rarely from the perivascular sheath of the vessels in the substance of the brain.

10. Last of the cancers is a tumour that has been found in the third ventricle—*epithelioma myxomatodes psammosum*, consisting of globes and cylinders of epithelial cells, embedded in a very bulky stroma of mucous tissue.

11. Springing also from the vessels, two forms of *papilloma* are met with—papilloma of the pia mater and vessels; and papilloma myxomatodes. The former is composed of a number of branching papillæ, each of which contains a blood-vessel with a small amount of connective tissue, and a double coat of epithelium, of which the outer layer is columnar. In the latter, which is probably a mere variety of the former, the structure of the tumour is the same, but the columnar cells secrete a vast amount of viscid mucus.

12. *Tubercle* springs from the middle tunic of the small arteries of the pia mater, or of the nerve-substance. It rarely attacks the membranes in the form of tumour, rarely also the white matter of the brain, but prefers as its principal seat the grey matter of the convolutions and of the deeper parts. Tubercle of the dura mater is, however, sometimes met with, and it may induce obliteration of sinuses. The cerebellum is a frequent seat of tubercle, which exists here in the form of superficial granulations. The pons also is frequently affected with tubercle, both in the form of small tumours of its substance, and as polypous tubercles of the fourth ventricle. Tubercle is separated from the surrounding cerebral substance by a very delicate reddish envelope.

Tubercular tumours of the cerebral substance are often multiple, and not unfrequently large; they are of very slow growth; persist long in the caseous state; and may be found cretified. Sometimes there is cerebral softening around them. Virchow states that the increase of tubercles takes place by apposition or juxtaposition, and that the apposition takes place not by layers primarily caseous, but by zones of new grey proliferation, usually in the form of miliary tubercle. A very delicate layer of connective tissue of new formation, a species of encysting false membrane, represents the mother-tissue for the subsequent generation of young tubercles.

13. *Glioma*, called by Billroth *granulated sarcoma*, or *round-celled sarcoma*, is practically a local hyperplasic development of the neuroglia. It may appear in three forms, either as a *soft glioma*, rich in cells—the most common kind; as *hard glioma*, fibrous, and, if the vessels are much developed, telangiectasic; or, thirdly, as a *myxoglioma*, a complex tumour, in which part of the tumour takes the appearance of mucous tissue. The nature of the tumour is partly determined by the nature of the tissue from which it springs; thus glioma of the brain is generally, but not always, soft; glioma of the ependyma hard. The soft gliomata are closely allied to myxomata. The intercellular substance is found in moderate quantity. In the more mucous gliomata the network is regular and large, and the tissue has little cohesion. If the meshes are larger still, and the mucous element abundant, this variety passes into a myxoma. If there be a considerable increase of cells, whilst the trabeculæ become narrower, we get a medullary glioma, which may be transformed into a medullary sarcoma if the cells continue to grow and multiply. These transitions are not uncommon even in the same tumour, especially in the posterior lobes of the brain. If the vessels are developed in great abundance we get hæmorrhages and a kind of fungus hæmatodes. Hard glioma is closely allied to fibroma, with which indeed it may be combined to form a fibro-glioma. In hard glioma the fibres are not arranged in a network, but in parallel lines, like felt. The nervous elements, naturally contained in the neuroglia, are absent in these tumours. The walls of the vessels are frequently thickened.

The glioma of the ependyma is of little importance; it is seen as fine granulations on the surface of the lateral ventricles in chronic hydrocephalus; on the floor of the fourth ventricle it may grow to the size of a cherry. In the cerebral substance, gliomata may attain the size of a fist, or even of a child's head; and they are often mistaken for cancers or sarcomata of the brain. Hard glioma may be distinguished from sclerosis, in that sclerosis encloses the normal nerve elements. In glioma, too, there is great proliferation of neuroglia cells. There is no distinct limit between glioma and the surrounding brain-substance, but the tumour on section shows greater vascularity, greater consistence, and a more transparent constitution, as well as often a bluish-white appearance compared with the white brain-matter. The demarcation in grey matter is imperceptible to the naked eye, especially if the glioma be soft. Soft glioma is generally single; hard is often multiple. The membranes may adhere, but form no part of the tumour.

Virchow thinks that glioma is not malignant; that hard glioma has an inflammatory origin; and that the soft variety is set up by local causes, such as injury. Gintrac, on the other hand, unites gliomata and sarcomata under the head of cancers.

Soft glioma is most frequently situated in the posterior lobes, less often in the upper and lateral parts of the cerebral hemispheres. It may be congenital. It gives rise to complications, namely, first, great congestion, causing cerebral compression, irritation, pain, excitement, or apoplexy; and, secondly, hydrocephalus of the ventricles, which in protracted cases is seldom absent. The latter occurs most rapidly in glioma of the optic thalami, or of the posterior lobe, compressing the choroid veins, the venæ Galeni, or the transverse sinus.

14. *Myxoma of the nerve-substance.*—This is not common in the brain. It owns the same origin as glioma, having the neuroglia as its starting point.

15. *Syphilitic gumma.*—Gummy tumours of the brain are generally found at the circumference, and especially at the base of the brain. Their origin is either from the membranes, from the vessels, or from the neuroglia of the cerebral substance. They have infective properties, or at any rate they are multiple, and may be met with at the same time affecting the dura mater, the pia mater, the brain, nerves, and cranial bones. They are often accompanied by inflammatory phenomena, a point which distinguishes them from large tubercles. Gumma is not the usual form in which syphilis attacks the dura mater on its external surface. It may, however, affect the arachnoid surface of the dura mater. In this situation the gummata may vary in size from a hemp-seed to a nut. They may be found just above the convexity of the hemispheres, or at the anterior part of the base of the brain, especially about the sella turcica, or on the tentorium cerebelli. They have been met with in the falx cerebri. The inflammatory condition around these tumours often unites them to the pia mater, and the subjacent portion of brain is frequently softened, either by the inflammation, or by arterial obliteration.

When the pia mater is united to the dura mater, gummata very small in size may form in the former membrane. The subjacent brain may be softened or sclerosed. Much larger gummata, however, from the size of a nut to that of a hen's egg, originate from the pia mater, and are most usually situated in the region between the optic chiasma and the pons, or on the crura cerebelli. On the convex surface they are much smaller. Gummata of the cerebral substance occur in situations most subject to traumatic influences. The chief seats are the cerebral hemispheres, the large ganglia, especially the optic thalami, and next in frequency the pons, and crura cerebri and cerebelli. The tumours attain to a good size, but are not so large as those of the pia mater. They may be multiple, but often exist singly. *See* Brain, Vessels of, Diseases of.

16. *Fibroma.* True fibromata, distinct from hard gliomata and sarcomata, probably do not exist in the brain or its membranes. Fibromata are essentially composed of connective tissue. Such increase in this tissue is sclerosis, and its arrangement is too indefinite, its amount too small, to be considered a tumour. Rindfleisch is probably wrong in stating that there are solitary tubercles of the brain which deserve rather to be called fibroid tumours; although it may be true that in some cheesy nodules of the nervous centres the growth of fibres and the condensation predominate enormously over the corpuscular structure. Practically, however, both *enchondromata* and *osteomata* are fibrous tumours. An enchondroma is a heterologous tumour not developed from a pre-existing cartilage, but produced by a change in the type of formation by proceeding from a non-cartilaginous matrix. Although osteoid enchondromata may be malignant, yet true osteomata are not so. These tumours may attack the cerebral dura mater, and on the convexity are multiple. If the tumour attack the falx cerebri it is solitary. Its starting-point is the internal surface of the dura mater. It is distinguished from exostosis of bone by having a fibrous layer between it and the bone. It may set up irritative pachymeningitis. Such tumours also are found small in connection with the cerebral arachnoid, as simple united patches or pointed prolongations. Their favourite seat is the convex surface of the anterior lobes. The nervous centres are very rarely the seat of these tumours. Their matrix is formed by connective tissue, not cartilage, the product of irritation of the neuroglia, and so a consequence of circumscribed encephalitis.

17. *Hydatids* are rare within the skull, but are met with occasionally in all parts of the brain, between the membranes, in the ventricles, and lying free at the base of the brain. They are more common in children than in adults. The brain may suffer from pressure either in the way of softening from interference with the vessels, or from sclerosis.

Cysticerci are also met with in various parts of the brain or its membranes. They may be surrounded by connective-tissue capsules; or may lie free, arranged in a racemose form. They may be single, or may attack the same individual in several hundred places at once.

Symptoms.—Even in tumours of considerable size all symptoms may be latent. The more tolerant portion of the brain will include the hemispheres and the white commissural regions, whilst the mesocephale, the optic thalami, and the corpora striata are amongst the least tolerant portions. It is not unusual, moreover, to meet with decided intermissions, especially in the early period of the disease; such intermissions depending on temporary lesions in the immediate neighbourhood of the tumour.

Even with these intermissions the diagnosis of the presence or position of the cerebral tumours would be comparatively easy, if the symptoms invariably depended upon direct excitation. Many of the phenomena pass the limits of the immediate sphere of the tumour, and are the results of reflex action. Sometimes also the symptoms due to direct and reflex excitation may coincide, and this is particularly the case in tumours of the base. The main difficulties lie in the possible latency of all symptoms; in their intermission; in the distinction and combination of direct and reflex excitation; and in the remissions following physical or psychical excitement.

Symptoms then may depend on direct or reflex excitation, and consist of exaltation of functional activity, such as contractions, partial or general convulsions, hyperæsthesia, and hyperideation. Others are produced by secondary lesions in the neighbourhood of the tumour—congestion, hæmorrhage, inflammation, &c.—and these may include not only all in the previous division, but temporary or persistent paralysis, fever, and other phenomena. Then there may be symptoms of direct compression, definite paralyses, and gradual enfeeblement of the sensorial and intellectual faculties.

Taking some of the more common conditions in

order, and viewing them as dependent on direct or reflex irritation, the most frequent certainly is headache; and except a tumour of the cerebellum, when the headache is almost invariably occipital, there is no symptom less useful in determining the position of the lesion. It is less frequently due to direct excitation than to reflex. The pain is very severe, indeed, more so than in any other disease, excepting, perhaps, meningitis: it persists through the whole malady; and is increased by vibration of all kinds, light, sound, or movement of the head. It may be confined to a single spot, or be diffused over the whole head. Connected with headache in many cases, and often equally the effects of radiated influence, are tinnitus aurium, morbid acuteness of hearing, and painful sensitiveness to sound; disturbances of vision, diplopia, muscæ volitantes, and strabismus, which may be transient; formication, and sometimes hyperæsthesiæ of greater or less extent. In some cases there is an agitated condition of the intellectual faculties, and even delirium. Disturbances of sight are very common. The retinal lesions will be subsequently described. It is a remarkable fact, as bearing upon reflex phenomena, that the affections of sight usually implicate both eyes, even where the tumour has involved only one optic nerve, and is not situated near the optic chiasma or the corpora quadrigemina. Hearing is far less often affected than vision. Generally a slight diminution only of this function is observed; and, in the rare cases in which complete deafness is met with, it is unilateral. Taste and smell are seldom interfered with. When these special senses are morbidly affected, the tumour in the first case will probably be located in the posterior portion of the base; in the second at the anterior half of the base of the brain.

The symptoms of compression may be included in the expression 'lowering of function,' comprising apathy, feebleness of memory, want of attention, confusion, and a general enfeeblement of ideas. These conditions are often accompanied or preceded by certain diffused symptoms, such as vertigo.

Vertigo is the first symptom in many cases: it is felt especially when the patient is in the upright position. It often produces uncertainty of gait, even where the tumour is not in the cerebellum. Strange sensations in the head are also complained of, a feeling of liquid in the head, or of a mobile body; or the sensation may be that of a solid body filling the head, or pressing upon some portion of it.

These phenomena often coincide with evidences of irritation of the mesocephale, whether due to direct compression or to radiated irritation of the medulla oblongata. Chief amongst these symptoms is vomiting. It is not accompanied by nausea or other manifestations of dyspepsia, and it will occur when the stomach is empty. It can frequently be checked only by keeping the patient in a recumbent position. Constipation also is often obstinate.

Epileptiform convulsion has an important bearing on the diagnosis of these lesions. Very frequently convulsion is preceded by many of the phenomena already touched upon, such as headache or vertigo. Frequently, however, convulsion precedes all other morbid phenomena, and the patient may be in perfect health in the intervals of the attacks. Given, therefore, convulsion as the one factor in forming an opinion, it is necessary to consider the liability of the patient to convulsive attacks from causes other than tumours; to realise whether the family history shows any suspicion of epilepsy; and to eliminate from the case the possibility of saturnine, alcoholic, and uræmic poisoning. If this is done, and especially if we find early convulsion associated with headache and with vomiting, this symptom will prove an important aid in the diagnosis of tumour.

The phenomena depending on the presence of tumour itself may be associated with others due to complications, such as œdema, congestion, encephalitis, or meningitis of the surrounding parts. A high temperature, for instance, will point to inflammation either of the nervous substance or of the meninges near the lesion; and meningeal inflammation seems to be accompanied by the highest temperature. Syphilitic gumma, however, may coincide with syphilitic meningitis on some other portion of the encephalon not directly connected with the immediate surroundings of the tumour.

Passing for the moment the subject of definite paralyses with the remark that the sphincters are seldom affected, even in cases in which the paralysis takes a paraplegic form, it may be mentioned that a want of equilibrium seems to be a not unusual evidence of the presence of tumour in the cerebellum. Aphasia may not only be due to the special localisation of tumour in Broca's region of the left anterior lobe, but also to the presence of this lesion in any part of the track (corpus striatum, optic thalamus, or crus cerebri) which unites this portion of the hemisphere to the medulla oblongata, the highway by which the centre for the production of articulate speech is connected with the co-ordinating centre for this function. Anæsthesia of the skin is seldom met with as a symptom of cerebral tumour. When present it is found only in the limbs affected with motor paralysis, and is scarcely ever complete.

Symptoms of special localities.—It remains to take special regions of the encephalon separately and to endeavour to differentiate the position of the tumour by the symptoms attending its presence.

Tumour in the *medulla oblongata* will be accompanied by various disturbances of sensibility, especially headache, and sometimes by convulsions. The pressure of a tumour is seldom limited to the medulla oblongata, and the symptoms therefore are complex. In several of the cases recorded there has not only been amaurosis and deafness of one side, but interference with taste and smell.

Tumour of the *fourth ventricle* may manifest itself by the presence of sugar or of inosite in the urine. Tumour here, as in the medulla oblongata, frequently destroys life quickly, before there has been time, so to speak, for much local lesion to be set up. Vomiting is a frequent symptom.

Tumour of the *crura cerebelli* and of the *corpora quadrigemina* cannot be diagnosed by any peculiar symptoms. In one case, in which the

corpora quadrigemina seemed wholly transformed into a tuberculous mass, the sight remained good, but there was double ptosis.

In tumour of the *cerebellum* there is little disturbance of sensibility except occipital headache. There are various disturbances of motility, especially convulsions and irregularity of locomotion, but no true paralysis. Amblyopia, amaurosis, and convergent strabismus are common. There is no interference with the psychical functions, or with speech, as a general rule. Vomiting is very common. In 76 cases collected by Ladame, there was no abnormality in the genital functions, except in four instances.

In tumours of the *pons*, the disturbances of sensibility are general or partial anæsthesia, and in some cases more or less headache. Hemiplegia of unequal degree on the two sides, and other forms of paralysis are observed, but no convulsion. Various and manifold disturbances of the special senses; phenomena of depression of mind; frequent alteration of speech; and early disorders in swallowing occur.

Tumours of the *crura cerebri* follow the example of the same lesion in the pons with reference to disturbances of sensibility. Equilateral hemiplegia opposite to the lesion is met with, and paralysis of the oculo-motor nerve on the same side as the tumour, often gradually extending itself to both oculo-motors.

Tumours of the *pituitary gland* are accompanied by intense frontal headache; by no definite disturbances of sensation or of motion; by double amblyopia or amaurosis, unequally developed; and by no loss of speech.

Tumours of the *middle cavities of the cranium* seem to affect mainly the third and the fifth nerves, anæsthesia or pains in the face and ptosis being the prominent symptoms, with some interference with the free action of the other muscles of the eyeball supplied by the third. In one case, in which a scirrhous tumour of the left side was situated on the inner surface of the sphenoid bone, extending laterally to the internal auditory meatus and backwards to the pons, not only were the third and fifth nerves paralysed, but colour-blindness supervened some time before death.

In tumour of the *corpora striata* and *optic thalami*, headache is less frequent than in other regions. Hemiplegia and convulsions are frequent, the former especially so. Hardly any disturbance of the special senses is observed. Intelligence and speech are frequently disordered.

In tumour of the *corpus callosum*, there is frequently some mental aberration, and often convulsions.

In tumour of the *middle cerebral lobes*, headache is frequently a prominent symptom, but otherwise the sensory disorder is mainly anæsthetic. Hemiplegia is common, as is also convulsion of an epileptiform character. These convulsive attacks are not rarely unilateral, and sometimes affect at first one limb only. In fact the position of a tumour towards the anterior portion of the middle lobe may be determined by symptoms with tolerable accuracy. Various disturbances of sight and of hearing are met with; as well as various psychical abnormalities, ranging from mere confusion of ideas to absolute imbecility.

In tumour of the *anterior lobes* there is general headache, seldom of the frontal region particularly. No other sensory disturbance occurs. Sight and smell are frequently affected, speech seldom. Hemiplegia, convulsions, and psychical disturbance will occur much as in tumours of the middle lobes.

In tumour of the *posterior lobes*, there is general headache, seldom localised in the occiput: no other sensory disturbance. Slightly marked hemiplegia occurs, and convulsive attacks are very frequent. There is no disturbance of the organs of special sense. The mental faculties are greatly altered, particularly in the tendency to depression.

All three lobes may be affected with tumour coincidently, and the headache is then very intense; the epileptiform convulsions exceed the paralytic phenomena; the organs of special sense are little affected; and there are various mental disturbances.

In tumour of the *convexity*, the headache is generally limited either to the frontal regions, to one side of the head, or to the occiput. There is neither anæsthesia, nor paralysis, but intense convulsions occur. The special senses are not disturbed. The mental condition is one of irritation, evidenced by delirium and excitement.

Lastly, very various regions of the brain may be simultaneously the seat of tumour, and the morbid phenomena will be necessarily complex.

Retinal changes.—It has seemed more convenient to speak of retinal changes dependent on cerebral tumour separate from the other symptoms. Great variations in the lesion occur according to the position of the tumour; its direct interference with the optic centres; its complication with meningitis; and its pressure on the optic nerves and chiasma.

Taking choked disc, optic neuritis, and atrophy of the optic nerve as the three chief lesions, cerebral tumour may very frequently induce choked disc, by interfering with the venous ebb from the eye; optic neuritis, if meningitis is associated with the tumour; optic atrophy, by pressure of the tumour on the optic nerve, or by this pressure of the tumour or of hydrocephalus secondarily induced by it on the optic centres or tracts, or by softening around the tumour, such softening implicating the optic centres, or, lastly, by the propagation of sclerosis. Any tumour situated far back in the encephalon may interfere with the venous flow through the venæ Galeni, and so produce hydrocephalus of the ventricles, and the retinal effects of hydrocephalus.

There are no retinal changes from tumour in the corpus callosum, nor as a rule from tumour in the optic thalami. Tumours of the cerebral hemispheres all influence the optic nerve, if they interfere with the base of the brain.

Tumours of the cerebellum may cause pressure on the lateral sinuses, the straight sinus, the venæ Galeni, or the torcular Herophili: pressure in any of these situations may produce choked disc. Or the tumour may affect the corpora quadrigemina; or softening around it may spread to these organs, and atrophy of the optic nerve be the result. *A fortiori*, tumour

of the corpora quadrigemina themselves will lead to atrophy of nerve.

Tumour of the crura cerebelli causes hydrocephalus, and its effects on the retina.

In a similar way tumours springing from the bone or the membranes at the base of the brain may produce choked disc or atrophy, according to the position of the pressure, optic neuritis by complications with meningitis, or neuro-retinitis by irritation of the connective elements of the nerves. *See* OPTHALMOSCOPE IN MEDICINE.

COURSE.—The clinical course of cerebral tumours is intermittent and paroxysmal. In many cases, such as those of glioma, it is very slow. Two groups of phenomena may complicate its ordinary course, namely, those associated with meningitis and apoplexy.

SPECIAL TUMOURS.—Aneurismal tumours may sometimes be distinguished by the sense of throbbing in the head; by the patient being of adult age or young; by his being attacked in the midst of perfect health; by vomiting being rare, apoplexy frequent, paralysis of cranial nerves early and unilateral; and by absence of mental phenomena. Aneurism situated in the cavernous sinus produces exophthalmos. *See* next article.

The symptoms of echinococci differ very little from those of other slow tumours: headache, dizziness, vomiting, syncope, and epileptiform attacks are most frequent. Disturbances of the motor and sensory functions, and also of the mind itself, are sometimes met with, and vary according to the situation of the lesion. The prognosis is unfavourable; the diagnosis impossible, unless echinococci exist at the same time in the liver.

Cysticerci manifest their presence in the brain by epileptic attacks, which augment in number and severity; the health of the patient between the fits is at first good, then apathy and torpor supervene; hemiplegia is rare, and never early; cranial nerve paralyses are exceptional; the symptoms are diffuse and bilateral, owing to the position of the parasite in the grey convolutions, and in many spots at a time. The age of the patient is above 40. Perhaps there may be evidence of the presence of cysticerci elsewhere.

Syphilitic tumours coincide with actual or previous syphilis. The headache attending this form of tumour is generally intensified at night.

In tubercle of the brain there is often a tuberculous family history, or the presence of tubercle elsewhere in the body. It seldom compresses cranial nerves. Its clinical evolution is often by paroxysms, and grave cases are combined with tuberculous arachnitis and hydrocephalus of the ventricles. Tubercle in the cortical substance of the brain and cerebellum may, however, be attended by no special symptoms.

In cancer also there is frequently a family history of this malady; and the cancerous cachexia may be present. Cancer seldom exists elsewhere when it is cerebral. This growth is much less often accompanied by symptoms due to congestion and hæmorrhage than glioma or sarcoma, being less vascular.

PROGNOSIS.—The prognosis of cerebral tumour is always bad, except in syphilitic gumma, and perhaps aneurism.

TREATMENT. — In syphilitic gumma and in aneurism large doses of iodide of potassium may be used with more or less success. This remedy is also useful in dispersing the results of the meningitis which so often accompanies tumour of the base. Beyond this there is little to be done, except in the endeavour to relieve pain and to support the strength of the patient.

E. LONG FOX.

BRAIN, Ventricles of, Diseases of. *See* VENTRICLES OF BRAIN, Diseases of.

BRAIN, Vessels of, Diseases of.

1. **Aneurism.**—The larger arteries of the brain, and their minute branches in the cerebral substance, are both liable to aneurismal dilatation.

(*a*) *Aneurism of the larger cerebral arteries* is more common than that of vessels of a similar size elsewhere. The large vessels of the base, or their primary branches, may be affected. The basilar and middle cerebral arteries are those most frequently diseased, aneurisms of those two vessels constituting three-fourths of the cases. Next in frequency is the internal carotid. The vertebral, anterior and posterior cerebrals, anterior and posterior communicating, and anterior cerebellar arteries are occasionally, but less frequently, involved. In one or two recorded cases the aneurism has been situated in the interior of the pons Varolii or cerebellum. The arteries of the two sides of the brain are affected with equal frequency, with the exception of the middle cerebral, which, with its branches, suffers twice as frequently on the left side as on the right. There may be more than one aneurism, situated on different arteries or on different branches of the same artery. The aneurism is usually sacculated, rarely dissecting. Its size varies from that of a pea to that of a nut, but aneurisms of the anterior or middle cerebrals have attained a much larger size. When this is the case the brain-tissue is pressed upon and softened.

ÆTIOLOGY AND PATHOLOGY.—These aneurisms are rather more common in men than in women. They occur at all ages, being more frequent before the ordinary degenerative period than aneurisms elsewhere. Nearly half the recorded instances have occurred between ten and forty years, and about one-seventh between ten and twenty. The change in the arterial wall resembles that giving rise to aneurism elsewhere —a fibroid degeneration, with loss of muscular and elastic tissue. This may be part of a widely spread arterial change, or more frequently is local. When local, it is sometimes due to syphilitic disease of the arterial wall, but still more frequently to the consequences of embolism. Dr. Church first pointed out the frequent association in young persons of cerebral aneurism and valvular disease of the heart, and many facts have been published which support the hypothesis that the aneurism in these cases may be the consequence of incomplete obstruction by embolism. There is often evidence of inflammatory and degenerative changes (thickening, calcification) in the arterial

wall after embolism, especially when the plug comes from an inflamed endocardium. If the obstruction is incomplete, the altered wall may yield to the blood-pressure. In harmony with this theory are the frequent absence of degeneration in other arteries, the frequency with which the left middle cerebral is the seat of the aneurism, and the occasional occurrence of several aneurisms on branches of the same arterial trunk. The efficient agent in the production of the aneurism is the high blood-pressure in the cerebral arteries.

Rupture has occurred in about three-fourths of the recorded cases of cerebral aneurism. The blood may escape rapidly or slowly, and the hæmorrhage may take place into the subarachnoid space, or into the adjacent cerebral substance. In the former case, meningeal hæmorrhage is the result. Rupture into the cerebral substance is not uncommon. An aneurism in the fissure of Sylvius may cause a hæmorrhage into the substance of the brain, bursting into the lateral ventricle; and an aneurism on the posterior cerebral artery may burst into the substance of the pons. Two causes may determine this rupture into the substance of the brain—first, thickening of the subarachnoid tissue adjacent to the aneurism, hindering its rupture outwards; secondly, the gradual escape of the blood, producing a slow disintegration of the brain-tissue, and thus preparing a channel for the effusion. In such cases only a small quantity of blood may have trickled into the ventricles or subarachnoid space. In rare cases a communication with a sinus forms, and constitutes an arterio-venous aneurism. This has occurred between an aneurism of the internal carotid and the cavernous sinus.

Symptoms.—Symptoms of the existence of an aneurism may be entirely absent. When present they depend on the pressure which the tumour exerts on neighbouring parts. They vary widely according to its seat, and they are rarely by themselves distinctive. Mental disturbance is uncommon. Headache is a very uniform symptom. It is often intense, sometimes throbbing, and may be localised, as in the occiput in basilar aneurism. Convulsions occur in some cases, and are said to be more common when the disease is near the medulla. Paralyses are frequent, and depend on the pressure of the tumour: the most common are those of the cranial nerves which lie adjacent to the aneurism, as of the nerves of the orbit in aneurism of the internal carotid. Such symptoms are suggestive of an aneurism when they indicate pressure in the known situation of a vessel. In some cases a murmur can be heard by the patient, and in still rarer cases (of aneurism of the internal carotid) it has been audible on auscultation. Aneurism elsewhere may increase the probability that an intracranial aneurism is present, and so, in the young, may valvular disease of the heart.

Rupture of cerebral aneurism gives rise to symptoms which vary, as in rupture of aneurisms elsewhere, according as the blood escapes quickly or slowly. If quickly, the blood usually escapes into the meninges and causes sudden apoplexy with general paralysis, rapidly deepening to a fatal issue. If slowly, the symptoms are less sudden, and unilateral paralysis or convulsion may occur. This is especially the case when the blood escapes slowly into the cerebral substance, unilateral symptoms occurring, and gradually increasing during a few hours or days, with or without initial loss of consciousness, but ending in fatal coma.

Treatment. — Little can be done in cases where intracranial aneurism is suspected. Even when it is of syphilitic origin, drugs can only partially restore the damaged and dilated vessel. Hypodermic injection of ergotin ($\frac{1}{6}$-grain) has been recommended by Langenbeck and advocated by Bartholow. Iodide of potassium may also be given. Rest is important. All causes of increased intravascular pressure, such as effort and low positions of the head, are to be avoided. The bowels should be kept regular. In rare cases where progressive paralysis of orbital nerves suggests the probability of aneurism of the internal carotid, and a murmur renders the diagnosis certain, ligature of the common carotid may be, and has been, resorted to with success.

(*b*) *Minute 'miliary' aneurisms* occur in the small arteries of the pia mater and substance of the brain (Virchow, Charcot and Bouchard). They are found at all ages, but more frequently in the old. They may involve vessels not more than the $\frac{1}{100}$ inch in diameter, but are most common on vessels a little larger than this; the walls suffer fibroid degeneration of the outer and middle coat, commencing, it is said, as nuclear proliferation. The muscular tissue of the middle coat disappears, and the whole wall at the spot becomes dilated into a sacculated aneurism, varying in size from the $\frac{1}{25}$ to the $\frac{1}{125}$ of an inch. These dilatations have been found in all parts, but most frequently in the optic thalamus, and next most frequently in the pons Varolii, the convolutions, the corpora striata, the cerebellum, the medulla oblongata, the cerebellar peduncles, and the centrum ovale (Bouchard). They often rupture and cause minute hæmorrhage. They are found frequently in cases of large cerebral hæmorrhage; and Charcot and Bouchard believe that such hæmorrhage is frequently due to their rupture. Liouville has pointed out that minute aneurisms of the retinal arteries sometimes coexist.

The rupture of a minute artery into its perivascular sheath distends it with blood, causing what has been termed a minute dissecting aneurism. Such are frequently met with in cases in which the vessels are exposed to extreme pressure, as in death from asphyxial conditions; or in the increased tension in collateral vessels when vascular obstruction has occurred.

No symptoms are known to be associated with the existence of these minute aneurisms. The symptoms of rupture are described under 'Brain, Hæmorrhage into.'

2. **Degeneration.** (*a*) *Of Arteries.* — The larger cerebral arteries are very common seats of the thickening of the inner coat, called by Virchow 'Endarteritis deformans,' and which, when fattily degenerated, constitutes 'atheroma.' On the cerebral vessels the fatty change occurs quickly and frequently; and opaque yellow

thickenings are the result. Only one or two of these may be present; or the change may involve the whole of the larger vessels at the base and extend for a considerable distance along the chief cerebral branches. The distribution of the degeneration may be symmetrical. It may coexist with a similar change in arteries elsewhere, or may be isolated. Degeneration of the cerebral arteries is common after middle life, being found in seven-tenths of the subjects examined (Bichat). It occasionally occurs much earlier, especially in cases of chronic Bright's disease. Bright's disease and alcoholism are its chief diathetic predisponents. The exciting cause of this disease is probably the strain to which the badly supported cerebral vessels are exposed. It is not easy to explain their occasional freedom from atheroma when this is abundant elsewhere. The degenerated patches rarely soften and open into the vessel, so as to permit the formation of a dissecting aneurism. More commonly they undergo calcification. The result of these nodular degenerations is to lessen the calibre of the vessel, sometimes to close it altogether, and to favour the formation of a coagulum. The lessened area of the vessel causes local anæmia of the brain. If the vessel becomes occluded, or if coagulation takes place in it, softening occurs in the part supplied by it. Where the degeneration has led to only slight thickening of the wall, the artery may be dilated at the spot. The degenerated vessel may burst under the pressure of the blood and hæmorrhage result. The minute arteries of the cerebral substance undergo similar changes, less conspicuous from their smaller size. Fatty degeneration of the cells lining the perivascular sheath is common at all ages. Under circumstances similar to those in which the larger arteries degenerate, all the coats of the small vessels suffer. Simple fatty degeneration of the middle coat occurs also at all ages. Miliary aneurisms may be formed, or rupture occur, as a consequence of these changes.

Symptoms.—Atheroma of the cerebral vessels leads to the symptoms of local anæmia of the brain, and is a common cause of the transient cerebral symptoms so frequent in the old.

Treatment.—Tonics, cardiac stimulants, and substances which, as cod-liver oil, promote the nutrition of the nerve-tissue, are the most useful remedies.

(*b*) *Of Veins.*—Degeneration of the walls of the veins is much less frequently observed than degeneration of the arteries, perhaps on account of the less degree of pressure to which they are exposed. Occasionally the veins of the pia mater may be found varicose in advanced life, and in one case recorded by Andral rupture of such a dilated vein was the cause of meningeal hæmorrhage.

3. **Embolism.** — Definition. — The obstruction of arteries or capillaries of the brain by solid particles carried by the blood-current from some other part of the vascular system.

Ætiology.—The source of the embolic particles is almost invariably situated between the pulmonary capillaries and the obstructed vessels, *i.e.* in the pulmonary veins, the left side of the heart, or the arteries. In arterial embolism it is necessarily so, since no particles large enough to obstruct even a small artery could pass through the capillaries of the lungs. In almost all cases the heart is the source of the plugs, a particle of fibrin being washed by the blood from a deposit on a diseased valve or in some recess (as the auricular appendix). Endocarditis, or chronic valvular disease, therefore, usually coexists with the embolism. Mitral stenosis is an especially frequent source of emboli, probably because the surface is commonly much altered, and the blood-current is in part slow (in diastole, allowing deposit), and in part very rapid (in auricular systole, detaching loose fibrin). Disease of the aorta—atheroma or aneurism—is the next most frequent source, and, less frequently, disease of the carotid or vertebral arteries, and coagulation in the pulmonary veins, large or small—the latter in some rare cases of inflammation and growths

Particles obstructing capillaries may come from some softened atheromatous patch or fibrinous deposit, from pigmentary formations, or from deposits in ulcerative endocarditis. In the last case the obstructing material has a septic character, and the inflammation it causes may be suppurative.

Anatomical Characters.—Almost any of the cerebral arteries may be obstructed, the internal carotids and middle cerebrals or their branches most frequently, the anterior cerebrals or the basilar less frequently, and the posterior cerebrals still less frequently. Obstruction of several vessels is sometimes found, having occurred at the same or at different times. The cerebral arteries of the two sides are plugged with nearly equal frequency; the internal carotid much more frequently on the left side than on the right. It seems that a large fragment is influenced in its course by the more direct path through the left carotid, while smaller fragments find their way with almost equal readiness to either side. The middle cerebrals are very frequently affected, sometimes on both sides; and, when the bilateral symmetry of the vessels is great, each may be obstructed at the same place.

The plug is usually arrested at some spot at which the vessel is narrowed by a branch being given off. Here the fragment may be found, usually decolorised, and commonly closing altogether the lumen of the vessel. On each side of this is a secondary clot: the distal extends far into the contracted branches of the vessel, the proximal as far as the next large branch. The obstruction may lead to inflammation of the wall of the vessel at the spot, especially when the plug has been carried from a place at which inflammation is going on. The inflammation leads to change of texture and degeneration, fibroid or fatty; the former may permit an aneurism to be formed, the latter may cause a thickened patch, in which calcification may occur. The inflammation may spread to the adjacent tissue, leading to induration around the spot.

The first effect of embolism is to arrest the blood-supply to the part to which the artery is distributed. It is only when the obstruction is beyond the circle of Willis that damage to cerebral structure (softening) follows. Softening

occurs more uniformly in obstruction of the arteries of the central ganglia than in those of the convolutions. Capillary embolism also causes softening, and when the obstruction is from a septic source, 'metastatic abscess' may result.

For the SYMPTOMS, DIAGNOSIS, and TREATMENT of cerebral embolism see BRAIN, Softening of.

4. **Rupture**.—Rupture of cerebral arteries is common and is the cause of cerebral hæmorrhage, and rupture of capillaries is not unfrequent. Rupture of veins is extremely rare, except as the result of injury.

(*a*) *Of Arteries.*—The proximate causes of rupture are weakening of the arterial wall, and increased pressure within the vessel. The conditions which give rise to these two factors are the remote causes of rupture. The actual rupture is commonly due to a temporary sudden excess of intravascular pressure.

ÆTIOLOGY.—The wall of the vessel is weakened, especially by degenerative disease—chronic periarteritis, or (rarely) simple fatty degeneration. Aneurismal dilatation and thinning may have resulted from the chronic change. In some diseases attended with a tendency to extravasation (purpura, hæmophilia, &c.) it is conjectured that the vascular walls have undergone rapid degeneration, or are unusually thin. Defective external support, from atrophy of the brain, causing increased size of the perivascular canals, was formerly thought to be a potent cause, and is now perhaps underrated. The mobile perivascular fluid which surrounds the vessels must afford a less efficient support than cerebral tissue.

When vessels are much weakened, they may rupture when the extravascular pressure is at, or even below, the normal; very commonly, however, there coexists increased pressure. Loss of arterial elasticity leads to a jerky pressure. Arterial degeneration, and still more constantly, arterial contraction, in Bright's disease, cause increased tension by obstruction; and the hypertrophy of the heart, which develops to overcome the obstruction, adds materially to the pressure within the arteries. Hypertrophy to overcome an obstacle near the heart has probably no influence in causing rupture of cerebral vessels.

The instant cause of rupture is generally some temporary increase of the blood-pressure due to effort—as in cough, straining at stool or vomiting; excited action of the heart; suddenly developed heart- or lung-disease obstructing the circulation; local obstruction to return of blood; contraction of the arterioles, general or local; or the action of gravitation in the recumbent posture. The last two causes probably acting together determine the frequent occurrence of rupture during sleep.

The conditions which produce these proximate causes are the remote causes of rupture. The most efficient are those which determine weakening of the vascular wall, and have been already spoken of (*see* DEGENERATION). Age is an important element—rupture is most common after fifty, but may occur from local vascular disease at any age. Hereditary predisposition is seen in a tendency to early degeneration. Position of degeneration is probably largely influenced by the distribution of the vessels: and the latter may be strikingly hereditary, as the retina sometimes shows. Sex tells probably by exposure to the greater pressure entailed by muscular effort (men suffer from rupture twice as frequently as women). Alcoholism leads to early degeneration. But the most efficient predisponent is Bright's disease, which leads to great intravascular pressure, and weakens the cerebral vessels by causing degeneration. It is probable that some acute diathetic diseases in which rupture is common act in a similar manner.

Certain of the cerebral arteries give way more frequently than others, especially the arteries of the corpus striatum and pons Varolii. This seems due (1) to their origin at right angles from vessels of very considerable size (basilar and middle cerebral), and their consequent exposure to the full pressure within the parent trunk. (2) To their 'terminal' character, which precludes collateral relief (Duret, Heubner). One artery, which very frequently gives way, passes from the middle cerebral through the anterior perforated spot, outwards between the island of Reil and the lenticular nucleus, the outer part of which it perforates, and then passes through the white 'internal capsule,' between the lenticular and caudate nuclei, to ramify in the anterior part of the latter. The arterioles supplying the convolutions on the surface of the brain are not often ruptured, except from injury. They are exposed much less directly to the blood-pressure, and sometimes possess considerable anastomoses.

SYMPTOMS.—The consequence of rupture of an artery is cerebral hæmorrhage, the symptoms and treatment of which are described elsewhere (*see* BRAIN, Hæmorrhage into). In traumatic laceration of the brain the arteries are torn, and often cause much hæmorrhage.

(*b*) *Of Capillaries.*—The minutest arteries and veins and the capillaries rarely rupture, except when exposed to sudden pressure by venous thrombosis, when the obstruction in the part from which the vein proceeds may determine numerous capillary hæmorrhages into the cerebral substance. In general venous congestion, as in asphyxial states, such hæmorrhage may occur; but a more frequent result is rupture of a vessel within its perivascular sheath, which thus becomes distended with blood.

FOR SYMPTOMS *see* BRAIN, Hæmorrhage into.

5. **Syphilitic Disease.** — The arteries of the brain are occasionally diseased in the later stages of syphilis. The large arteries at the base and the minute arterioles may be both involved. The wall is thickened at circumscribed areas by a fibro-nuclear growth, which causes a nodular projection on the exterior, and diminishes also the calibre of the vessel. The structure of the growth resembles that of syphilomata elsewhere. It is said by Heubner to begin by a nuclear proliferation between the inner coat and the elastic lamina; and in some cases it attains its chief development in this situation, the elastic lamina being pushed outwards and the lumen of the vessel obliterated. The middle coat may ultimately disappear. Vessels may form in the substance of the growth, and its centre may undergo fatty degeneration. The disease is sometimes sym-

metrical on the arteries of the two sides. The growth or secondary thrombosis occluding the vessel, softening may result in the area of brain-tissue supplied by it. The softening resembles in its occurrence and characters that which is produced by degenerative changes in the arteries, but is more varied in its seat, and it affects younger persons. The diminished elasticity of the diseased wall, when the thickening is slight, may permit the dilatation of the vessel into an aneurism. Possibly the same result may follow the fatty degeneration of the new tissue.

Symptoms.—No symptoms are produced by the arterial disease until it causes local anæmia or softening, the symptoms of which resemble those due to other causes.

Treatment.—This is that of the later stages of syphilis. It must be remembered that the removal of arterial disease may not restore the damaged cerebral tissue.

6. **Thrombosis.** Thrombosis,—the coagulation of the blood *in situ*,—may occur in the cerebral arteries; or in the cerebral veins and sinuses.

(*a*) *In the Arteries.*

Ætiology.—The causes of arterial thrombosis are the following:—

(1) An alteration in the wall of the artery, by which the blood comes in contact with an abnormal surface. The most common condition is atheroma, and hence arterial thrombosis is most frequent when atheroma is most common—in the old. Syphilitic disease of the artery sometimes leads to it. Much more rarely it is caused by an arteritis, spontaneous, or the result of adjacent inflammation or traumatic damage.

(2) Retardation of the blood-current. This may result from weakened action of the heart in debilitating diseases (as phthisis and cancer), and in extreme fatigue. It may be part of the effect of a convulsive fit; or it may be caused locally by the arterial diseases mentioned already, which lead to narrowing and loss of elasticity.

(3) An increased tendency of the blood to coagulate. This is seen in many diseases, especially in marasmic states in young and old (such as are caused by phthisis and cancer), in acute rheumatism, and in the puerperal condition. A slight cause then suffices to produce coagulation, and the weak heart, so common in many of these conditions, may cause sufficient retardation of the blood-current.

(4) Lastly, thrombosis in an artery may be *secondary* to its complete or partial obstruction by an embolus.

Anatomical Characters.—The arteries occluded may be one or several, and large or small. Of large arteries the basilar, middle cerebral, and carotid are those occluded most commonly, and with nearly equal frequency. The vascular wall may present any of the local causative conditions, or may be healthy. After a time thickening from secondary arteritis occurs. Within this vessel is a coagulum which usually fills its interior, and is adherent to the wall. It may not fill the vessel, either because originally imperfect, or because the clot has shrunk. A recent quickly-formed coagulum is red, but after a time it becomes pale and yellow. A slowly-formed coagulum is pale, and may be laminated. A secondary clot usually forms far into the contracted distal branches, and on the proximal side as far as the nearest large branch. Ultimately the clot may, rarely, soften, the channel being sometimes re-established. More commonly it undergoes calcification, or, with the artery, contracts and becomes atrophied. The brain-tissue, in which the artery was distributed, may be at first anæmic, but quickly becomes congested. It ultimately undergoes softening—red, yellow, or white, according to the amount of vascular distension. If the collateral circulation is free it may remain unsoftened.

Symptoms.—Where chronic arterial disease is the cause of thrombosis, the symptoms of local cerebral anæmia may precede (*see* Brain, Anæmia of). The thrombosis itself leads to the symptoms of loss of function in the part to which the artery passed. The onset of these symptoms is slow or sudden, according to the rapidity with which the coagulum forms; and their degree depends on the size of the vessel occluded, its position, and its relation to other vessels which may supply blood to the area involved. Thrombosis of a small vessel in the cerebral substance usually leads to transient brain-disturbance, headache, vertigo, tingling, and temporary weakness in the limbs, which soon pass away if a collateral circulation is established; more slowly, if softening ensues, by compensatory action elsewhere. The occlusion of a large vessel causes commonly more marked symptoms. Complete hemiplegia is frequent, and its onset may be marked by loss of consciousness (*see* Brain, Softening of).

Diagnosis.—Diagnosis rests on a combination of the symptoms of local cerebral disease with the causal condition—vascular mischief (indicated by probable age, degeneration elsewhere, or syphilis), and with conditions leading to relaxation of the blood-current, or increased coagulability of the blood. The diagnosis is rendered more probable by the symptoms if slight being transient, if severe being of gradual onset, and, whether slight or severe, being preceded by the premonitory indications of local cerebral anæmia.

The prognosis and treatment of thrombosis in arteries are considered under its consequence, Brain, Softening of.

(*b*) *In Cerebral Veins and Sinuses.*

Ætiology.—Thrombosis in sinuses may be primary, and due to changes in the constitution or the circulation of the blood; or secondary, and due to local causes inducing coagulation directly at the spot affected. The same conditions of retarded circulation and altered blood-state which permit coagulation in arteries, favour it also in veins, and it is often seen in such conditions as phthisis and cancer, and especially in marasmic states in children. Local retardation of the circulation from narrowing of the sinus, or compression of the jugular vein, occasionally assists. Local change causing coagulation is usually the extension to the sinus of adjacent inflammation, or of a clot produced in a tributary vein by such inflammation. Caries of the bones of the skull, especially of the temporal bone, and meningitis are common causes. Inflammation outside the skull, in the scalp, neck, or face, has

led, by means of venous connections, to intracranial thrombosis. Lastly, injuries of the skull involving the sinuses sometimes cause coagulation in them.

Anatomical Characters.—Of primary thrombosis the superior longitudinal sinus is the most common seat, and thence the clot spreads into the veins on either side, and often also into the lateral sinuses. When secondary, the thrombosis occurs in the sinus nearest to the local mischief; in disease of the petrous bone, the lateral sinus is usually involved. The sinus is distended by firm clot, commonly (not invariably) adherent, sometimes in concentric layers. The walls of the vessel are healthy when the thrombosis is primary or secondary by extension of clot, but thickened and brittle when invaded directly by adjacent inflammation. After a time the clot may soften and break down.

The consequence of venous thrombosis is local arrest of the blood-current, the tributary veins and capillaries becoming enormously distended with blood and rupturing, and the cerebral substance being crammed with minute capillary extravasations which often coalesce. The condition is frequently seen in the convolutions. Blood is also effused into the meshes of the pia mater, and into the subarachnoid space. Into the looser tissues and into the ventricles serum may escape. Thrombosis of the veins of Galen is one cause of ventricular effusion. Ultimately the brain-tissue, the seat of the ischæmic congestion, undergoes softening, first red, and then yellow or white. Occasionally the softening of the clot leads to pyæmia.

Symptoms.—The symptoms are at first those of mental excitement, namely, intense headache and muscular spasm, shown as contractions in the limbs, or as convulsion, often beginning locally, according to the position of the congestion. These symptoms, after one or several days, are succeeded by those of depression; with coma, and dilatation of pupils. The coma may come on suddenly, and the first stage may be little marked. Convulsions, when present, often continue till death. When the superior longitudinal sinus is plugged, epistaxis, œdema of the forehead, and exophthalmos have sometimes been observed. When the lateral sinus is obstructed, there may be painful œdema behind the ear, and the jugular vein on that side has been noticed to be less full than on the other.

Diagnosis.—The diagnosis rests on the occurrence of severe cerebral symptoms in association with a causal condition, constitutional or local.

Prognosis.—This is always serious, death being, in most cases, speedy.

Treatment.—The indications for treatment are mostly causal. In primary thrombosis stimulants and nutritious diet are necessary, and tonics if they can be taken. In secondary thrombosis, occurring in robust individuals, leeching or cupping is recommended; purgatives should be given; and, in the less severe cases, a blister may be applied to the neck, and the utmost care taken to afford free exit for pent-up inflammatory products. Pain and convulsion are relieved most effectually by cold to the head.

W. R. Gowers.

BRAIN-FEVER. A name popularly applied to any kind of febrile state in which symptoms of cerebral excitement are prominent; as well as to cases of inflammatory disease of the brain or its membranes.

BREAK-BONE FEVER. A synonym for Dengue. *See* Dengue.

BREAST, Diseases of.—This subject will be treated under the following divisions:—

I. *Diseases before puberty*, in both sexes. II. *Diseases about the age of the establishment of puberty; and after that period*, in the female,—(A), in the *active* state of the gland; (B), in the *passive* state. III. *Diseases* affecting the rudimentary organ *in the male*. IV. *Diseases of the nipple*.

The diseases of an organ composed essentially of glandular structures have here to be described. The mammary gland is classed with those termed racemose; but it differs from every other organ in the body of a similar class, inasmuch as it only arrives at maturity when its function is to be subservient to the nourishment of the offspring. In its perfection it appears, normally, only in the female sex, and even then it does not become developed until the internal organs of generation are capable of performing their functions.

Hence, to describe systematically the diseases of the breast, it is requisite to treat of them not only in reference to sex, but also in relation to the different periods of life at which certain diseases appear. Briefly then, from a histological point of view, they occur: (*a*) in the rudimentary state of the gland; (*b*) in its mature state; (*c*) when it has become a secreting organ; (*d*) during a state of degeneration.

I. In the *rudimentary period* of the gland the tissues composing it are rarely liable to morbid derangement. Usually, soon after birth, especially in male infants, the rudimentary nipple and the skin of the region within the zone of the areola become slightly elevated and of a pink hue. In some infants a secretion, slightly milk-like, oozes from the ducts. In this state, the injudicious rubbing practised by the attendant excites inflammation, which, if not arrested by desistance from that pernicious interference, may advance to suppuration. When that happens, the usual local application of warmth and moisture suffices to give relief.

II. *About that age, in both sexes*, when the development of the generative organs advances with greater rapidity to maturity than in early life, the breast-gland enlarges, and may be painful, thus causing anxiety to the individual. Usually, symmetrical development takes place in the female; but, when the gland of one side takes precedence of that on the other, the circumstance need only be regarded as a departure from the ordinary rule, for no trouble will result, and in due time both will attain their normal proportions. In the male, pain or uneasiness sometimes occurs for a few days about this period, very often excited by the pressure of the dress. The removal of this cause is sufficient to arrest further mischief.

In the female the development of the breast having reached maturity, the gland is now asso-

ciated by sympathetic influences communicated through nervous stimuli with the functions of the pelvic generative organs. This physiological fact should ever be remembered when investigating the nature of the morbid affections of this organ.

In a clinical point of view, it is essential to examine the diseases of the breast under the two states before mentioned, namely, (A) whilst the gland is undergoing metamorphosis into a secreting organ, and during lactation. (B) As a mature gland, but passive as regards its function.

Glancing at the various morbid states of the body of the gland as a whole, they may be divided, primarily, into two groups:—the *Functional* derangements; and the *Organic* or histological diseases.

We will now proceed to discuss these affections, as they are presented at the different periods mentioned above.

A. After conception the breasts soon begin to enlarge, and at their borders and surface minute pisiform indurations may be felt. Occasionally, but very rarely, this normal increase in bulk is attended with considerable pain and irritation extending throughout the nervous relations of the gland. The pain is referred to the back, neck, inside of arms, shoulders, and side of thorax, over, in fact, the area of distribution of those filaments which pass off to the skin from the same dorsal branches of the spinal nerves, the intercostals which send filaments to the breasts. It affords a good example of reflected irritation. This state usually occurs after the first conception, and in women of excitable, nervous temperament. Attention to ordinary hygienic measures during the progress of the metamorphosis of the organ into a secreting gland, with its accomplishment, affords relief to the pain. In large, lax, pendulous breasts, the separate lobes of which each is composed may excite apprehension of the existence of a tumour. But tumours composed of new tissue are so extremely rarely developed during pregnancy, that the greatest caution must be exercised in the diagnosis of their nature.

Very rarely, no change whatever in the breasts accompanies pregnancy, under which circumstances there is an absence of the secretion of milk after parturition—**Agalactia.**

Inflammation of the Breast.—Mastitis.

Ætiology.—Before lactation, inflammation of the breasts is very uncommon. Afterwards, on the contrary, it is very frequent. This morbid state is often the result of carelessness or ignorance on the part of the nurse. The slightest unusual fulness or 'knottiness' discovered after the infant has been sucking, and when the ducts and their terminal secreting vesicles should be empty, requires immediate attention. Congestion of a lobule or lobe with milk produces the nodule, and the cause of the impediment to its escape should be sought for. The state of the nipple is generally the cause of the difficulty. Either the orifice of a duct may be obstructed by epithelium, or a superficial ulceration around one exists. The morbid or defective states of the nipple are the most fruitful causes of inflammation and its results in the breast. Prophylactic measures should always be instituted when there is reason to fear that a defective development of the nipple will interfere with the free flow of the milk. Even with some mothers it would be advisable to resign the duty of suckling, rather than subject themselves to the almost certain misery arising from persistent and ineffectual attempts to do so. Inflammation, generally passing on to suppuration and abscess, either within the body of the breast or on its surface, is most frequent in primipara, and within the first month after parturition.

Symptoms.—First, hardness is felt, 'a knot,' in some part of the substance of the organ; this enlarges, and may attain to considerable dimensions before causing pain or even uneasiness. Next, pain is felt during suckling; this increases each time the infant sucks, and 'the draught' is produced. The integuments then become pink, and afterwards red, tense, shining; more or less of the breast feeling very inelastic, firm, prominent, and heavy. Pain is now often very severe, and great constitutional disturbance is excited. In the centre of the redness the skin becomes of a purplish tint, around this it is œdematous, and with the finger, at the centre of the purple zone, a slight depression and softening spot can be detected. An abscess now exists, and in proportion to the quantity of pus fluctuation is more or less marked. At the purple centre the cuticle has probably by this time separated from the cutis, and a vesicle containing serum, either yellow or slightly tinged with blood, indicates that ulceration of the cutis is proceeding, and that the pus will soon escape. The above is a brief description of the objective signs indicating the morbid processes noticeable in all cases of local inflammation advancing to and terminating in suppuration and abscess. It is not possible to state with any degree of exactness the period of time required for the accomplishment of these definite changes. It varies according to so many local and constitutional circumstances, that it would be idle to attempt to predict any certain definite period or stage for each phase. It will be more useful to describe the treatment by which the progress of the disease may be arrested or limited and its painful course mitigated.

Treatment.—Great attention should always be given to the nipple of primiparæ. In many women, this important division of the gland is very small and undeveloped, perhaps only on one side, so that the infant, especially if not very strong, has great difficulty in obtaining sufficient milk to appease the appetite, and its efforts cause pain in the part. This circumstance induces the mother to prefer suckling most with that breast the nipple of which is perfect, and the infant soon appreciates the advantages of that side. Consequently the gland-tissue of that breast having the imperfect nipple becomes congested. Every time the infant sucks it becomes worse, more and more pain and irritation are excited, the orifices of one or more of the ducts in the nipple become blocked, and perhaps the infant refuses to suck the breast. But the gland becomes more and more distended, the nipple deeply buried, until at last suckling is impracticable. Probably none of these increasing troubles have been stated to the attendant surgeon; and, when he is consulted, he finds the

breast to be in the state above described. The perfect development of the nipple should be always a subject of anxious solicitude on the part of the obstetric practitioner. If that organ be imperfect, precautions should be taken to prevent the gland itself from becoming congested, and if the infant cannot draw the milk sufficiently, some mechanical means should be employed to effect this object. The nipple itself should be carefully examined. If its end be more than usually coated with a white secretion, or the openings of the ducts seem to be obstructed with an excess of epithelium, attempts may be made to remove it. If minute abrasions, ulcers, 'cracks or chaps,' are visible between the rugæ, some soothing application should be used. Frequent ablution with warm water, even the contact of a little moist cotton fibre covered with tissue gutta-percha, is very preferable to the dry dress; or, if there be much secretion from the glands on the nipple, after cleansing its surface, some dry powder, such as carbonate of magnesia, oxide of zinc, or starch powder is beneficial.

When actual congestion of the gland-tissue exists, mechanical means should be used to reduce it. Supporting the gland with strips of plaster and a bandage is sometimes very useful. When inflammation is excited, local applications of warmth and moisture are indicated, and the constitutional condition of the sufferer demands special attention. When suppuration has taken place, its relation to the adjacent parts and the exact site of the abscess when formed should be carefully examined. Great diversity in the progress, duration, and sufferings of the patient depends upon the locality of the pus. It may be situated over the body of the gland, within it, and beneath it. When overlying or superficial to the body of the breast, the course of the disease is rapid, the pus soon points and escapes, and the wound heals. In those cases the constitutional disturbance is usually trifling. Water-dressing before and after the escape of the pus is preferable to the heavy poultices usually employed. The entire organ may be supported with strips of adhesive plaster and a bandage during cicatrisation. But a bandage dexterously applied should be always used.

Both the local and constitutional symptoms are much more severe when inflammation affects the body of the gland, and pus collects between its lobes. The progress of the disease is tedious, pointing of the pus slow, and the exact spot at which it may reach the surface is for a long time doubtful. In the majority of cases it makes its way between the ducts and reaches the surface near the areola or within its area; usually to the sternal side of the nipple, where the gland tissue is thinnest. The surgeon should note this fact, for as soon as he can detect a softening of the cutis, by ulceration, he may, with advantage, make an incision at that spot, and thus give immediate relief by facilitating the escape of the pus. In these cases recurrent abscesses are not uncommon, and therefore the incision should be free, and its premature closure by adhesion must be avoided. All incisions should be made in a line parallel to the course of the ducts, never transversely to their axis. Manual pressure to hasten the escape of the pus is not admissible, the natural contractility of the tissues being quite sufficient for the purpose.

When the abscess forms behind the breast the local appearances are quite characteristic. The gland itself seems little involved, but it is pushed prominently forwards and seems to repose upon a cushion of fluid. To the touch the elasticity of the swelling is very striking, and, without producing additional pain, a slight bulging of the walls of the abscess may sometimes be produced at the periphery of the gland when, with the palm of the hand and outspread fingers, compression is made from the front backwards against the thorax. The patient should be recumbent. The pus in these cases often points somewhere around the borders of the body of the gland.

During the time occupied in the formation of a mammary abscess and its local treatment, the constitutional powers of the patient must be well supported, and the general health maintained by every means.

The *sequelæ* of suppuration in an organ composed of so much connective-tissue, and endowed with its peculiar function, frequently cause great trouble. They are protracted induration, sinuses, and fistulæ, through which last the milk persistently escapes. Induration of the whole or part of the breast subsides when lactation ceases, and the organ in due time resumes its healthy state. Sinuses and fistulæ may require incisions, but the ordinary plan for their cure should be adopted before having recourse to a treatment often involving much subsequent deformity.

At the time for weaning the infant inflammation rarely occurs. Considerable milk-congestion of the secreting structure may sometimes produce irritation and inconvenience, to be relieved by mechanically drawing the milk in just sufficient quantity only to diminish the fulness.

Galacticele.—An accumulation of milk, to which the above term is given, forms a tumour in the connective-tissue of the organ, and results from the bursting of a lactiferous tube. The swelling always appears first during lactation. It may vary in size from time to time; sometimes enlarging rapidly as suckling goes on. Two varieties are met with. In one form there is a single swelling near the nipple, quite superficial, and quickly recognizable by its objective signs. In the other there may be several swellings distinguishable in the substance of the gland, as well as on its surface, all of comparatively small size, very firm and globular. In the same gland they vary very much in size, and in the degree of resistance they offer to manipulation. The discrimination between these tumours and others in the breast is easy, if the surgeon is able to ascertain with exactness that the swelling appeared somewhat suddenly during suckling, and that its size varied conformably with that function.

In cases of long standing, the contents of the cyst become solid in proportion to the quantity of the fluid constituents of the milk absorbed, and the cyst wall itself is very often rigid and even may become gritty.

Treatment.—The treatment of this malady consists in cutting into the cyst, removing its contents, and allowing the wound to heal by granulation.

B. The diseases affecting the mature gland, in its *passive* state, *from the age of puberty to that period of life when the catamenia cease*, may be grouped as follows:—the *functional* affections, or those which are characterised by changes in the secreting portion of the gland, accompanied by more or less induration, inconvenience, and pain; the *organic*, or those diseases characterised by some new-growth, formation, or tissue-structure altogether a superaddition to the organ, and growing within its sphere of nutrition, often resembling, more or less, gland-structure in composition; and others the minute elements of which are nucleated cells of various shapes, definitely and diversely arranged.

In this state of the breast *inflammation* rarely occurs. Nevertheless, both the acute and chronic varieties of that morbid process terminating in abscess are met with, and careful discrimination is necessary to avoid mistaking such diseases for tissue-tumours, especially in patients above forty years old. The history of the case, tactile examination, and the variations occurring during the progress of the affection, commonly suffice for the detection of such cases. The treatment should be the same as for abscess in general.

Functional Derangements.—The functional derangements of the breast in its passive state demand special attention. They are characterised by a peculiar activity of its secreting portion, which undergoes structural changes of a specific kind. When the tissues composing a mature gland, but perfectly passive, are examined with a microscope, the cæcal terminations of the ducts are scarcely perceptible, and little else than fibre-tissue is seen. Here and there, perhaps, cæci may be detected containing minute aggregations of epithelium. But when, under some sympathetic excitement, with derangement of the functions of the pelvic generative organs, the secreting cells of the gland become active and are distended with epithelium, they induce more or less enlargement of the breast. But of such affections there is this important fact to be noticed. The whole breast need not be necessarily involved. On the contrary, one lobe only may be excited, and when this occurs the existence of a tumour is declared. When, after excision, such enlarged lobes are carefully examined with the microscope, normal gland-tissue is seen, the cæcal ends of the ducts are readily recognised, and their immediate association with the excretory ducts may be observed. The former are gorged with epithelium; and true gland-tissue, less its peculiar secretion, has been developed.

Symptoms.—Associated with this state of the tissues of the breast, the patient complains of pain, both locally and spread over a very wide area. To express as briefly as possible the superficial regions affected and over which pain is felt, the reader must be reminded of the distribution of the nerve-filaments of the lower cervical plexus, and of the dorsal from which the second, third, fourth, and fifth middle and anterior intercostal nerves pass off. From these, special filaments are distributed to the breast; and to the site of exit of one or more of them at the intercostal foramina, the course of the pain is referred by the patient. The skin of the neck, shoulder, side of thorax, and inside of arm receives filaments from the same source. Hence an explanation of the widely-diffused pain.

It is of the first importance to discriminate between this state of the gland-tissue and substantial new growths, especially because the latter cannot be removed by natural processes, whilst the former most probably will be. The objective signs are the following:—to the touch the excited gland-tissue is nodular, irregular over its surface, much identified and mingled with the body of the organ. If the whole breast be large and relaxed, the tips of the fingers may be insinuated between the borders of the indurated lobe and the lobes not affected. If the entire body of the gland be morbidly firm, it feels like a disc-shaped mass lying on the thorax, under the borders of which the fingers can be pressed. Occasionally, at one or more spots along the periphery of the gland irregular nodules are perceptible, projecting into the connective-tissue around them. When one lobe is affected, the shape of the induration corresponding with that of a lobe, namely, broad at the periphery and gradually narrowing towards the areola, may be detected. Pain as a subjective indication is of great assistance in the diagnostication of these cases; but the source and course of the pain must be carefully traced. Generally manipulation of the induration produces increased pain; occasionally touching the induration, even however gently, is intolerable, and persistence in or repetition of the act strongly opposed by the sufferer. Light pressure should be made over the intercostal foramina, both the middle and anterior, when the pain excited thereby will correspond with the nerve-filaments of the affected lobe. Usually, pressure along the upper dorsal spinous processes excites pain also. The morbid affections above described occur in single women, married but sterile females, and young widows, at ages between twenty years and forty. More or less disturbance of the catamenia co-exists, either in relation to the frequency or quantity of the discharge. The patient complains of languor, inability for bodily or mental exertion, and is desponding and often alarmed for the possible consequences of the affection suggested by sympathising friends. She becomes irritable, restless at night, loses appetite for food, as well as all desire for social enjoyments, and becomes highly susceptible and emotional.

Diagnosis.—An exact diagnosis of these hisological changes may be made if the manipulator examines the organ methodically. He should, first, gently grasp the induration between the thumb and fingers, when it will be distinctly appreciable. Afterwards, placing the palmar surface of the fingers over the surface of the breast and gently pressing backwards against the thorax, the induration cannot be detected. Should there still remain any doubt on the subject, let the patient recline on her opposite side on a sofa, and in this posture, if there exists a substantial new-growth, the integument is usually elevated by it.

Treatment.—The treatment of these cases consists in attention to the general health. Every

hygienic direction should be enjoined, and such medicines administered as conduce to its improvement. Local soothing applications are usually futile, and, except in those cases of extreme pain, are not advisable, since it is desirable to avoid manipulation of the part, and the frequent recurrence of the patient's thoughts to it. Should the gland be heavy and pendulous, a suspensory bandage, as thin as possible, may be adjusted.

New Formations.—We shall next describe the diseases of the mature gland arising from the development of new formations—either of tissues constituting new-growths; or of conditions causing collections of fluid of distinct and specific kinds. All of these may be thus arranged in three groups:—first, the *fluid* tumours; second, the *solid*: and, third, those composed of both *solid and fluid*.

A. **Cysts.**—The *fluid tumours*, commonly termed *cystic*, consist of a membranous sac with its contents. Now, calling to mind the histological divisions of the breast, and dwelling on the structural differences between its parts, the secreting apparatus and the excretory, there is little difficulty in assigning to the cysts their true histological affinities. Thus there are cysts associated with the secreting apparatus; others with the excretory, the ducts; and some due to the extravasation of the gland's secretion, the milk, into the connective tissue. Effusions of blood also give rise to the development of cysts, either independently of other diseases or associated with them. Another variety of cyst is produced by the development of entozoa, notably of echinococcus hominis. An ordinary examination of the fluid derived from these cysts at once establishes the fact that heat and the admixture of nitric acid produce coagulation in that abstracted from some of them, whilst that from other cysts remains unaffected by the treatment. The cysts are thus divisible by the nature of their contents into two distinctly defined groups:—

a. Those containing fluid without the admixture of any coagulable element.

b. Those enclosing fluid which does contain coagulable material. Other characteristics of these two fluids are not less conspicuous.

From an objective point of view all cystic tumours of this gland may be classed in two groups, thus:—first, those associated with its ducts, the evidence of which is afforded by the escape of fluid at the nipple; and secondly, those not connected with the ducts by any such evidence.

The following tabular arrangement will place before the reader, at a glance, all the varieties of cysts met with in the breast.

I. *Cysts associated with the ducts*, communicating and connected with them.

1. Containing milk.
2. Enclosing growths; with serum, coagulable and often tinged with blood:—
   a. Adenoid growths.
   b. Granulation cell-growths.
   c. Cancer.

Cysts not connected with the ducts.

1. Surrounding effused blood.
2. Enclosing milk.
3. Simple cysts. } Fluid not coagu-
4. Entozoon cysts. } lable.
5. Investing growths; with serum coagulable, tinged with blood and containing cholesterine:—
   a. Adenoid growths.
   b. Granulation cell-growths.
   c. Cancer.

1. We have described above, under the name *galacticele*, a tumour observed during suckling and composed of milk. But, occasionally, the surgeon is consulted about a swelling which, at first sight, would seem to have no reference to that function. Nevertheless the milk, or all that remains of that secretion, constitutes its entire bulk. If exact enquiry be made, the patient states that a tumour has existed, unaccompanied by pain, from the period of the last weaning, perhaps not having been observed until the gland ceased to secrete, and that its size slowly diminished until a certain period, since which it has remained of unvarying bulk. This decrease is due to the absorption of the serum of the milk, and the solid parts remain. The cyst should be incised, the contents removed, and the wound allowed to heal by granulation.

Cysts containing the solid parts of the milk are sometimes associated with perfectly new growths of the glandular type.

2. True *sero-cysts*, that is to say, a collection of serum circumscribed by a fibrous membrane, are frequently met with, and are most commonly associated with adenoid, granulation, and cancerous growths. They occur in the breasts of middle-aged women. The fluid which these cysts contain is sometimes quite clear, and of a yellow tint; at others it is tinged with blood-colouring matter, and is turbid. It always contains some constituent coagulable by heat and the admixture of nitric acid. These are the exudation-cysts of the mammary gland. After the fluid has been removed with a trocar and canula the cyst soon refills.

3. Other cysts containing a fluid like serum, until its composition is carefully examined, are developed in the breast, and are probably associated immediately with the secreting part of the gland. For the sake of identification the writer would designate them *mucous cysts*. The contained fluid is not coagulable by either heat or acid. Its colour is brown, more or less inclining to a greenish hue; it is opalescent, of variable specific gravity—about 1020, rather greasy when rubbed between the fingers, and exhibits an alkaline reaction. When sufficient quantity is collected in a test-tube and allowed to cool, in a few hours the lowermost stratum of the fluid becomes clearer than the upper. The uppermost always remains opalescent. If a little of this last be examined with a microscope, oil globules are seen, together with the bodies called colostrum cells. The greasy nature of the fluid can be detected by smearing a drop of it on a piece of glass.

The development of these cysts is not very common. We may here remark that they seem to have escaped the observation of surgeons, as no special notice of them occurs in the most recent monographs. Yet they are so distinctly separated from all the other cysts which are

formed in the breast, in respect of the composition of their fluid contents, their progress, and their prognosis, that they constitute a marked, distinct, and isolated class. We meet with them in the breasts of single women, in married but sterile females, and in widows between forty and fifty years of age. Usually they are accidentally discovered in any quarter of the gland when about an inch in diameter. Their shape is globular or ovoid; to the touch elasticity is the main feature, and if sufficiently large and superficial, fluctuation may be detected. In some instances the tips of the fingers may be insinuated into a sort of furrow around them. Pain is rarely complained of. The treatment consists in emptying the cyst with a trocar and canula. After this the fluid does not again form. These cysts usually appear singly and in one breast only, but the writer has seen a patient in whom they were multiple and on both sides.

4. Cysts containing blood—*hæmatomata*, are very rarely formed in the breast, except in association with some new-growth from which blood, or more often bloody serum, oozes.

5. True *entozoa-cysts* are developed in the breast. They are certainly rare, and cannot be distinguished from other cysts until incised. Extirpation by excision is the speediest means of effecting a cure.

B. **Solid Tumours.**—We have next to describe the solid tumours. These are essentially new growths of tissue superadded to the normal gland. Generally, therefore, a characteristic feature of the existence of such growths is an increased bulk of the affected organ; another, the firmness or resistance to pressure with the fingers when contrasted with the group of tumours before described. The solid tumours have long been classed in regard to their local and constitutional effects, and their results on the life of the individual affected with them, into two groups—the *innocent* or harmless; and the *malignant* or life-destroying.

1. *Adenoma.*—In the first class are placed those growths more or less closely resembling in their tissues those composing the glandular structure of the breast. Various terms have been assigned to these tumours, namely, Chronic mammary tumours, Pancreatic Sarcoma, Tumeur adénoide, Corps fibreux, Hypertrophie partielle, Mammary glandular tumour, Fibroma, Adenocele. Their composition is chiefly fibre-tissue, the cæci or acini of secreting structures, with more or less distinctly marked traces of ducts, being interspersed throughout the mass. The elementary nucleated cells are those of the gland and fibre-tissues.

Adenomata are developed in the breasts of young, unmarried women from the age of puberty upwards; rarely after thirty, but very commonly before that age. They may be intraglandular, occupying the substance or body of the gland, and having the normal gland-tissue investing them. In other instances they seem to be attached by a kind of pedicle either to its surface or margin. In every instance they are placed within the fascial investment of the organ. When attached, as just described, their remarkable mobility, slight lobulation of surface, and firmness, coupled with the youth of the patient, are sufficient indications of the harmlessness of their nature. Usually they occur singly and in one breast; they may be multiple and in both breasts. The only means by which they can be removed is excision. However large the tumour, its removal should be always attempted without cutting away any portion of the normal breast. In most cases this can be done, especially if the patient be youthful and the growth of medium size, even should it be developed in the body of the gland and extend through it to the pectoral muscle. After thirty-five years of age it is expedient to remove the breast as well. Want of space precludes a lengthened histological description of these growths. It must suffice to state that a section shows a solid, uniform surface, divided into lobes and lobules by fibrous septa, sometimes slightly broken up by fissures or clefts in which there appears a little clear tenacious fluid. The growth is often very succulent, at other times only moist; its hue may be greyish, yellow or almost white. Its vascularity is scarcely perceptible. The prognosis of these cases is invariably favourable. In many instances excision is not necessary, and the surgeon must be guided in recommending an operation by the exigencies of the case specially under observation.

2. *Fatty tumour.*—Lipomata or masses of adipose tissue are developed in the breast, or rather in relation with it, to speak with accuracy. They are characterised by the usual indications, and require no special mention.

3. *Nævus.*—It may be questioned whether nævus, or a growth of true trabecular vascular fibre-tissue, is ever developed in the substance of the breast, that is to say, in the gland-tissue. The integument around the mammilla may certainly be so affected in early life before the development of the gland, and a subcutaneous nævus may exist at the site of the future organ; but to describe such a growth, in a girl of *six* years old, as a recent writer has done, as an example in which the whole organ was like a sponge and as large as half an orange, must be regarded as an error in pathology.

4. *Fibro-plastic.*—Under the term 'fibro-plastic' we include a group of new-growths composed of elementary nucleated cells of a fusiform or oval shape, disposed in a stroma of more or less fibre-tissue. They are developed in women of middle age, increase rapidly, and after excision are liable to grow again.

5. *Colloid.*—Colloid growths are very rarely met with in the breast. They appear in middle life, and are not distinguishable from other solid tumours until after excision.

6. *Carcinoma.*—Carcinoma, commonly called cancer, is developed in the breast in two distinct forms. The first, and most common, is that variety which is due to infiltration of the normal tissues of the gland by the elementary cells of cancer. It constitutes the *scirrhous* variety, the *carcinoma fibrosum* of the present day. The second is that kind which is produced by the development of a mass of true cancer-growth, and is termed *tuberous*, often *medullary*. Both varieties are met with in women after forty years of age, but the first much the most fre-

quently. Previously to that age the disease is rare; from forty to fifty it is most commonly seen; and it becomes relatively less frequent as age advances. A larger number of married women are affected by it than single, and prolific women who have suckled their children are quite as prone to the disease as the sterile or those who have not suckled.

Symptoms.— *Scirrhous* cancer commences in any region of the mammary gland, although most frequently perhaps in the axillary segment. A small, firm nodule is usually accidentally discovered, without the attention of the patient having been attracted to it by pain. Rarely, the whole organ is simultaneously infiltrated, but most frequently one lobe only is affected. The infiltration is often central in the body of the gland, especially when the organ is atrophied, and the reverse occurs when the extreme edge of a lobe is affected at its periphery. The infiltration may steadily increase until the whole breast forms a rigid, solid mass, but most frequently the larger part of the organ remains unaffected. The disease gives rise by its contraction to much deformity of the region, to dimpling, corrugation, and irregularities of the otherwise rotund integumental surface. The nipple, just in proportion to the effect of the growth upon the ducts, becomes retracted or drawn towards the tumour. Such are the ordinary objective signs of infiltrating cancer in its early stage. The progress made by the disease is subject to very remarkable variations in different individuals, and the stage above described may be long delayed. In some cases many months or even years may elapse before the growth assumes any grave importance. Sooner or later, however, the integument over the growth becomes adherent to it, infiltrated, and red, and advances towards ulceration. An ulcer now forms, the edges of which are everted, ragged, and attached to the growth beneath. A hole extending into the tumour becomes deeper and deeper; ichorous discharges, more or less profuse, continue without much pain; and the patient becomes at last worn-out, or succumbs to the ravages of a cancerous growth in a vital organ.

The *tuberous* variety commences in a small circumscribed, globular nodule in the body of the gland; grows rapidly; separates the lobes of the organ; extends equally in all directions; and becomes adherent to the skin, which commonly sloughs and allows of a protruding, fungating mass.

In both varieties the axillary lymphatic glands sooner or later become involved in the disease, which may also spread to those in the neck and within the thorax.

Treatment.—Local applications exert little if any influence on the growth of cancer, but certainly those which reduce the local temperature are the best. The vital powers of the patient should be supported as much as possible by hygienic measures, and especially by ferruginous tonics. The removal of the primary growth before the contamination of the lymphatic system is of great importance, but whether by excision with a scalpel, or by means of escharotics, space will not admit of discussing. The writer inclines to the first method in the majority of cases.

C. **Mixed Tumours.**—To the group of mixed tumours belong:—1 Those composed of cysts, intracystic growths, and solid interspersed masses of new tissue. 2. *Granulation cysts*—cysts with growths attached to their walls, the elementary tissues of which resemble those of ordinary granulation-growths—whence the term applied to them. 3. Cysts, so-called, often formed upon the surface of cancers, in consequence of the slow exudation of serum from the growth itself.

1. Tumours of the first class belong pathologically to the group of adenoid formations, and although they differ so remarkably in their external objective appearances, they are, when unalloyed with other growths, perfectly harmless. The sero-cystic disease of Brodie, and the proliferous cysts of Paget belong to this class.

2. The *granulation-cystic* growths constitute a class of themselves. It is only of late years that attention has been attracted to them. They are rarely met with, and when pure are unattended by untoward circumstances.

3. To the third class belongs a group of cases thoroughly cancerous in their nature, and differing only from the ordinary forms of that disease by the accidental formation of cysts. *See* Tumours.

III. Diseases of the Male Breast.—The male has sometimes a well-developed mammary gland, and the part is subject to the same diseases as the female. But the simple enlargement of the organ is harmless, and should not be interfered with. At the age of puberty the mammary region often becomes painful, owing in part to the pressure of the dress upon the mammilla and the rudimentary organ. Inflammation followed by suppuration has been observed at this time.

IV. Diseases of the Nipple.—A *defective formation* of the nipple is of grave importance, and when it exists measures should be adopted to assist its elongation. This is to be done by using an exhausting glass, such as those employed to empty the gland of milk.

Inflammation and its effects produce much suffering, and at the period of suckling frequently excite deep-seated mischief. The small ulcers, called 'cracks,' 'chaps,' &c., which form between the rugæ on the apex and sides of the nipple, may be cured with an application of water-dressing, or by powdering the part with carbonate of magnesia or oxide of zinc, far more readily than with ointments.

Pendulous cutaneous growths occur on the nipple, and should be excised.

Cystic follicular tumours are sometimes seen within the zone of the areola. *See* Nipple, Diseases of.

John Birkett.

BREATH, The.—The expired air, or what is familiarly termed *the breath*, is important both from an ætiological and a clinical point of view, and the object of the present article is to present a brief summary of the main facts relating to this subject, with which, for practical purposes, it is necessary to be acquainted.

1. The **ætiological** relations of the breath will be more appropriately discussed under the general subject of ætiology (*see* Disease, Causes of), but a few of the more striking examples of the manner in which it affects the health may be

given here. It is well known that the expired air, if re-breathed by the same individual without having been purified by a proper admixture with atmospheric air, will produce serious effects upon the economy, and will ultimately lead to death by asphyxia. Again, the breath of a number of persons collected together in an ill-ventilated place may prove injurious to such individuals; the impure atmosphere thus generated tends to lower the general health, to retard the development of the young, to increase the virulence of infectious diseases, and to predispose to pulmonary affections. Indeed, some writers regard re-breathed air as one of the most prominent causes of pulmonary phthisis. Further, undoubtedly the expired air is a most important channel by which the poison of different infective diseases—for example, that of measles, scarlatina, or diphtheria—is conveyed from one individual to another. It has been affirmed that phthisis can be transmitted directly in this manner, but adequate proof of this statement is entirely wanting.

2. In a **clinical** point of view, the expired air may afford useful information in diagnosis; or it may present characters giving important indications for prognosis and treatment. It might be requisite in different cases to submit the breath to a more or less complete examination, and the following outline will serve to suggest the particulars to which attention should be directed in this examination, and to point out the practical uses which it may serve.

a. The breath has been made use of to distinguish between *real* and *apparent death.* For this purpose a delicate feather or a light is held before the mouth or nostrils, and it is noted whether either of these is disturbed; or a cold mirror is placed before the mouth, when, if breathing is going on, its surface will be clouded by the moisture condensed upon it. These tests are, however, not considered very reliable.

b. The *temperature* of the expired air may be important to notice. In some conditions it becomes exceedingly cold, and this may be readily perceptible to the hand, the breath having a chill feel, or it may be visible in consequence of the moisture in the expired air being condensed, even when the surrounding atmosphere is warm. This phenomenon is observed, for instance, in the collapse-stage of cholera. On the other hand, the temperature of the breath may be raised more or less, as in febrile diseases.

c. Chemical examination of the breath may prove of service, and it is probable that this might afford useful information, if it were resorted to more frequently than is the custom at present. In the first place this examination may be employed to determine the proportion of carbonic acid present. In certain affections, as during an attack of asthma, or in cases of extensive bronchitis, the amount of carbonic acid in the expired air is more or less increased; in others, such as in the collapse-stage of cholera, this ingredient may be very deficient. Again, chemical examination of the breath may reveal the presence of a poison in the system, introduced from without, for example, hydrocyanic acid. It has also been employed to show the existence of deleterious products generated within the body, especially in cases of renal disease. It is affirmed that ammonia may be detected in the breath in some cases of this kind, by holding a glass rod dipped in hydrochloric acid before the mouth, the ammonia being a product of the decomposition of urea.

d. Microscopic examination of the expired air has been attempted, but at present no results of practical value have been obtained.

e. The *odour* of the breath is the most important character demanding attention in a practical point of view. It is easily recognised, and the practitioner should always be on the alert to notice the smell of the breath of a patient, as this often affords material aid in diagnosis, and may even reveal certain morbid conditions which otherwise are liable to be entirely overlooked. Besides, patients not uncommonly seek advice on account of 'foulness of breath,' as a symptom for which they require special treatment. The following summary will indicate the principal circumstances under which this clinical phenomenon may prove of service in diagnosis, and in the course of the remarks it will be pointed out in what conditions the breath is particularly offensive. At the outset it must be observed that in some individuals the breath seems to have naturally a more or less disagreeable odour, which cannot be referred to any particular cause, and this amounts occasionally to extreme foulness. In females this may only be noticed at certain periods, and in some instances it seems to pass off in course of time. Again, it must be borne in mind that the breath is frequently unpleasant, either temporarily or constantly, from persons eating certain articles of food, or indulging in certain habits, such as excessive smoking, chewing tobacco, &c.

(i.) The odour of the expired air may aid in recognising poisons in the system. The smell of prussic acid or laudanum, for instance, may be revealed when either of these is present in the stomach. Alcohol, however, chiefly demands attention in this relationship. In cases of acute alcoholic poisoning, the odour of the alcohol or of its products is at once apparent; and in persons who are found in a state of unconsciousness, the cause of which is not known, the smell of the breath is made use of as one of the diagnostic signs of drunkenness, though it must be taken with great caution. It is in the chronic forms of alcoholism that the breath gives the most valuable information. In very marked cases of chronic alcoholism it has an intensely foul odour, which is quite characteristic; but it gives extremely important indications in less confirmed cases, where the other symptoms of alcoholism are not so apparent; and especially does it enable us to detect dram-drinkers, and to explain the symptoms of which they so frequently complain. These persons, if their habits are inquired into, generally give themselves an excellent character for temperance, and seem entirely to forget that those with whom they come into contact are endowed with organs of smell. Again, the breath may reveal the presence of certain metallic poisons in the system, of which mercury is the most important example, but lead may also affect its odour. The expired air is said to present the odour of ammonia in exceptional instances of uræmia,

due to the exhalation of carbonate of ammonia derived from the decomposition of urea.

(ii.) The breath has a peculiar, or more or less disagreeable odour, in connexion with several diseases. That which is associated with the febrile condition is well known. In various disorders of the digestive organs the breath is often very offensive, but it is not practicable to refer any particular odour to particular diseases of either of these organs; it may, however, be affirmed that an unpleasant smell is frequently associated with habitual constipation. In cases of stercoraceous vomiting the breath may have a fæcal odour. In this relation it may be mentioned that in some cases of phthisis the writer has noticed a sickly smell of the breath which is quite characteristic, and which seems to depend upon the state of the stomach. In cases of cerebral diseases also, the breath often becomes exceedingly offensive, on account of the condition of the alimentary canal. Local morbid conditions about the mouth, throat, or nasal cavities constitute a most important class of affections which influence the odour of the breath; in many cases it becomes extremely foul, and may be quite peculiar in its characters. Among these conditions should be specially mentioned want of cleanliness of the mouth and teeth; decayed teeth; diseased bone in the mouth or nose; ulceration or gangrene about the mouth, especially cancrum oris, and gangrenous ulceration along the gums; suppuration, ulceration, or gangrene in the throat, either of local origin, or associated with syphilis, scarlatina, diphtheria, &c.; ulceration of the nasal mucous membrane, and chronic ozæna; and malignant disease. The smell of the breath is of special value in drawing attention to some of these conditions, for they may exist without giving rise to any local symptoms whatever, and the patient may be quite unconscious that there is anything wrong. Several striking illustrations of this statement have come under the writer's observation. Again, certain conditions of the respiratory organs are liable to affect the odour of the expired air, and may render it unbearably fœtid. Among these may be mentioned sloughing ulceration about the larynx, pulmonary gangrene in any form, and the decomposition of retained morbid products in dilated bronchial tubes or in certain cavities. Here, again, the smell of the expired air may reveal what otherwise is liable to be entirely overlooked, and especially when the patient coughs, so as to expel some of the retained air out of the lungs. Lastly, the breath may have a peculiar odour in some special diseases, such as pyæmia and diabetes.

Treatment.—It is only intended here to offer a few remarks as to the treatment of *foulness of breath*. The first great indication is, of course, to seek out the cause of this symptom, and endeavour to remove or remedy this, by which in a large proportion of cases a cure may be readily effected. The habits should be duly regulated; the mouth and teeth properly cleansed; the alimentary canal maintained in good order and any special affection requiring treatment attended to. When unpleasant breath depends on the stomach, it may often be improved by taking charcoal powder or biscuits, at the same time remedies being employed suitable for the particular affection present, and calculated to promote the functions of the alimentary canal, the bowels being also kept freely open. When the bad smell depends on local causes, it may be diminished by the use of antiseptic mouth-washes and gargles, such as solution of Condy's fluid, carbolic acid or creasote. Antiseptic inhalations are indicated when the respiratory organs are accountable for fœtor of breath.

Frederick T. Roberts.

BREATHING, Disorders of. *See* Respiration, Disorders of.

BRIGHT'S DISEASE.—The term *Bright's Disease* is now universally recognised as generic, and as including at least three different diseases of the kidney. Each of these maladies involves chiefly one of the individual structural elements of the organ, and only secondarily affects the others. There is thus a disease originating respectively in the uriniferous tubules, in the blood-vessels and particularly in the Malpighian tufts, and in the fibrous stroma. That which originates in the tubules is always inflammatory in its character, although the inflammation may be *acute* or *chronic*; that which commences in the vessels consists in a peculiar degenerative change, the so-called waxy, lardaceous, albuminoid, or amyloid degeneration; that which is proper to the stroma is an extremely chronic process, supposed by many to be inflammatory, but as it appears to others, rather of an hypertrophic character. In the following article are described:

I. The *inflammatory affection*, affecting the tubules, or the stroma, or both.

II. The *waxy* or *amyloid affection*, originating in the vessels.

III. The *cirrhotic* or *gouty affection*, originating in the fibrous stroma.

Definitions.—I. *Inflammatory Bright's disease* is an acute or chronic affection of the kidneys; caused by exposure to cold, and by scarlatinal and other blood-poisons; consisting in inflammation of the elements, passing through various stages of transformation, viz. inflammatory enlargement, fatty degeneration, and atrophy; characterised in the earlier stages by diminution of urine, albuminuria, frequently hæmaturia, tube-casts, and dropsy; in the later stages by the same symptoms, in a more or less marked degree, with secondary changes in the heart, blood-vessels, and other organs; terminating frequently in recovery in the early stage, rarely in the later, often in death by dropsy, uræmia, or intercurrent affections.

II. *Waxy Bright's disease* is a chronic affection of the kidney, caused by phthisis, syphilis, caries, suppuration, and other exhausting conditions; consisting in waxy or amyloid degeneration of the Malpighian bodies, small arteries, and sometimes the basement membrane, with, in many cases, transudation into the tubules; passing through various stages of transformation, viz. simple degeneration, enlargement from transudation, and atrophy; characterised by a large flow of albuminous urine of low specific gravity, and absence of dropsy; often attended by evidences of waxy disease of other organs, particularly the liver, spleen, and intestinal canal; resulting pro

bably in some cases in recovery, usually in death by exhaustion, uræmia, or coexisting affections of the kidneys and other organs.

III. *Cirrhotic Bright's disease* is a chronic affection of the kidney, caused generally by the abuse of alcohol, sometimes by the poison of gout, occasionally by plumbism, and by unknown conditions; consisting in increase of the fibrous stroma, with thickening of the capsule, and ultimate atrophy of the organ; characterised by a very insidious commencement, by the absence of the early symptoms of either of the other forms, by albuminuria, at first slight, but possibly absent, and by the ultimate appearance of enlargement of the heart, polyuria, albuminuric retinitis, œdema of the lungs, and uræmia; resulting ultimately in death from uræmia, œdema of the lungs, or other intercurrent affections.

Ætiology.—I. Of the *inflammatory form.* Cold is the commonest cause in the adult. It acts especially on those who have been exposed to its influence whilst perspiring. It frequently contributes towards the production of the disease in persons otherwise predisposed. Various blood-diseases, while they induce temporary albuminuria along with their more ordinary symptoms, have renal inflammation as a common sequela. Among these scarlatina occupies the first place, diphtheria stands next in order, followed by erysipleas, measles, pyæmia, typhus, ague, acute rheumatism, and pneumonia. Many of these maladies being most common in childhood, it follows that in the earlier years of life they are the chief causes of inflammatory Bright's disease. Pregnancy, heart-disease, gout, and malaria contribute towards its production in some cases; and the undue use of cantharides, turpentine, or alcohol may also be reckoned as causes.

II. Of the *waxy form.* Constitutional syphilis, phthisis, prolonged suppuration, caries or necrosis of bone, and other exhausting diseases, such as cancer and chronic rheumatism, induce this degeneration. There is at present no satisfactory evidence as to the precise connexion between these influences and the morbid process.

III. Of the *cirrhotic form.* The commonest cause is the abuse of alcohol, particularly in the form of ardent spirits. After this, though at a long interval, rank gout and lead-poisoning. Congestion from cardiac disease is also by many authorities, but erroneously, held to be a cause. (*See* Kidneys, Congestion of.) As experience shows that the disease is often met with in people who have neither indulged in alcohol, been exposed to lead, nor suffered from gout, it is obvious that other efficient though yet undiscovered causes must exist.

Anatomical Characters.—I. Of the *inflammatory form.* When a case of this kind is prolonged, the renal disease passes through several conditions, which, for convenience of description, may be divided into three stages. (*a*) *Stage of active inflammation.* In this stage the kidney is enlarged; its capsule strips off readily; its surface appears more or less red, sometimes of a deep purple colour; and occasionally extravasations of blood are present in its substance. On section the cortical substance is found to be relatively increased in bulk. Its vessels, as well as those of the cones, are congested. The structure appears somewhat coarser than natural, while the convoluted tubules often present a swollen opaque appearance, and occasionally contain blood. On microscopic examination the congestion of the vessels becomes very apparent, and the tubules are found to be dark and opaque, their lumen being frequently occluded. The individual epithelial cells are granular, and in a state of cloudy swelling. In some cases almost all the tubules appear affected, in others comparatively few. The enlargement of the organ is in part due to congestion, in part to exudation into the tubules. As the exudation increases the congestion becomes less marked, so that in the later period of this stage the kidney appears paler and more opaque. Unless recovery or death takes place, this condition passes into (*b*) The *second stage*, that of *fatty transformation.* In this stage the organ is still enlarged. Its capsule strips off readily; the surface often presents stellate veins, and its colour is mottled. At this time extravasations are very rarely observed, but there are alternating patches of yellowish opaque sebaceous-looking material, mingled with more natural structure. On section the cortical substance is seen to be relatively increased. There is no congestion of the vessels, and the Malpighian bodies are not prominent. The convoluted tubules are in many parts occupied by the sebum-like material, and sometimes the straight tubules present the same appearance. On microscopic examination the tubules alone are found affected. Many of them present under low powers a black appearance, due to fatty degeneration of the contents of the tubules. It is in the cells alone that this change occurs, and not, so far as the writer has seen, in the free exudation which binds the cells together. Many of the tubules are completely blocked up by this material; and sometimes in making the section there is such an amount of oil set free, that it permeates the whole structure of the organ, and is liable to produce the impression that the fatty degeneration is universal. This condition may be developed within a week or two of the commencement of the inflammation, and it may continue for years. During the whole course of the second stage it must be understood that inflammatory action is going on, although much less acutely than at first, and less widely diffused. The disease is sometimes recovered from, and if the patient survive long enough it passes into (*c*) The *third stage*, that of *atrophy.* The organ is then reduced to or even below the natural size. Its capsule strips off with little difficulty, and without tearing the surface. The surface is uneven; it rarely appears coarsely granular, as in the cirrhotic form, but rather presents a series of depressions, which give it an uneven or finely granular character. Its colour is very similar to that described as occurring in the second stage, but there is less of the sebaceous-looking material. On section the cortical substance is found relatively diminished. The Malpighian bodies are not prominent. The tissue feels more dense; and many of the tubules are occupied by sebaceous-looking material. The blood-vessels,

and particularly the small arteries, are sclerosed; the intima and the adventitia are frequently, the middle coat almost invariably, thickened. The fibrous stroma is relatively increased, especially towards the surface of the organ, and the tubules may be traced in different stages of atrophy. On close inspection that atrophy is found to result not from pressure of the fibrous stroma, but from molecular absorption of the contents of the tubules. Besides the typical form of the inflammatory affection just described, notice should be taken of other varieties, such as the *glomerulo-nephritis* of Klebs, in which the glomeruli are especially affected. The anatomical changes met with in other organs are described along with the complications.

II. Of the *waxy* or *amyloid form*. This chronic morbid process may also, for convenience of description, be divided into three stages. Of these the first is, (*a*) *The stage of degeneration proper*, in which the organ presents an almost normal appearance. The size is natural; the capsule strips off readily; and the colour is not altered. On section all appears normal, excepting that the Malpighian tufts, without being congested, are prominent, and in certain lights may be seen even by the naked eye to present dim translucency characteristic of waxy degeneration. On applying a little aqueous solution of iodine, the Malpighian tufts and the small arteries assume a peculiar mahogany hue. On examination with the microscope, the stroma and tubules are found to be healthy, the vascular structures being alone affected. The affection is often first seen and is most distinct in the middle coat of the arteries, the swollen transverse fibres taking on the colour, and producing what has been described as the ipecacuanha-root appearance. How long this condition may last without the tubules becoming affected it is impossible at present to say, for it has only been met with in patients who had died of one or other of the causal complications while the renal malady was still in an early stage. Sooner or later it passes, however into the condition most commonly met with, (*b*) the *second stage*, that of *degeneration with secondary changes in the tubules*. In this condition the organ is enlarged. Its capsule strips off readily, the surface is smooth and pale, presenting, in pure examples, little or no mottling. On section the cortical substance appears relatively increased, and looks much paler than the cones. The structure usually is denser than natural. The vessels appear prominent, and the Malpighian tufts resemble minute grains of boiled sago. On the addition of iodine the degenerated parts become characteristically coloured, and stand out prominently from the tubular tissue, which does not exhibit the characteristic reaction. On microscopic examination the vessels are found altered as in the earlier stage, but the change is more advanced. The stroma is normal, but many of the tubules are altered. Some are blocked up by a dimly translucent, wax-like material, which however does not assume the mahogany colour on the addition of iodine. The epithelium in many of the tubules presents a finely granular appearance, and occasionally is somewhat fatty, but the epithelium and the basement membrane very rarely present the characteristic reaction. This change in the tubules is thus secondary to the degeneration proper, which is confined to the vessels, and these secondary changes consist in some alteration of the nutrition of the epithelium, with exudation or transudation of coagulable material into the lumen of the tubes. This condition may last for years, but should the patient live long enough it passes into (*c*) the *third stage*, that of *atrophy*. The organ is then below the normal size; the capsule strips off readily; the surface presents an uneven granular appearance, and is pale. On section the cortical substance is found relatively diminished. Its small arteries are prominent and thickened; its Malpighian bodies are very conspicuous, and are grouped together in consequence of the atrophy of the intervening structure. The stroma is relatively increased, and many of the tubules are destroyed, while of those which remain not a few present the characters above described as being met with in the second stage. The organ may, in extreme cases, be diminished to less than half its natural size.

III. Of the *cirrhotic form*. The course of this affection is even more chronic than that of the waxy form. It consists essentially in an increased growth of the fibrous stroma, with secondary changes in the tubules and vessels. In an early stage the organ may be found of fully the natural size. The capsule strips off less readily than in health. The surface is somewhat uneven, and may present cysts. On section the cortical substance is relatively enlarged, and this is due merely to an increase of the stroma, not to any change in the vessels or in the tubules. But it is in the more advanced stages that the disease is commonly seen. Then the organ is reduced in bulk, it may be slightly, it may be to one-fourth of its normal size. Its capsule cannot be peeled off without tearing the gland. The surface is uneven and granular, and often of a reddish colour. On section the cortical substance is found relatively diminished, its structure being dense and fibrous. The small arteries are thickened and very prominent, all their coats, but especially the middle, being increased in volume. Many of the tubules are atrophied, but the epithelium of such as are not involved is for the most part natural. Cysts are numerous, and are found in connexion with the tubules, the Malpighian bodies, and the cells.

There are two points worthy of being specially kept in view by those who desire to attain to clear conceptions of Bright's disease—viz. (1) That its different forms are very frequently combined—in particular that the inflammatory affection is found associated sometimes with the waxy disease, sometimes with the cirrhotic; but that the descriptions here given are derived from pure examples of each process; and (2) that atrophy results in all the forms if the disease lasts long enough; that is, that a small, uneven-surfaced kidney may result from either the inflammatory disease of the tubules, or the waxy disease of the vessels, as well as from the increased growth and subsequent contraction of the fibrous stroma in the cirrhotic form.

Symptoms.—1. Of the *inflammatory form*. The leading clinical features of this variety, in

addition to the albuminuria which exists in all the forms of Bright's disease, are diminution in the quantity of urine, and the presence of dropsy.

The onset of the disease may be sudden or gradual. Sometimes it is the diminution and alteration of the urine that attracts attention, sometimes the dropsy, sometimes the gastric derangement and general uneasiness; but whichever symptom may appear first, the others usually speedily follow. The urine is generally diminished in quantity, often somewhat opaque, and smoky or even bloody. It contains much albumen and numerous tube-casts. The casts are granular, being composed mostly of epithelium in a state of cloudy swelling; sometimes bloody; frequently hyaline or fibrinous. The urea is diminished, it may be, to one-half, one-fourth, or even a less proportion of the natural amount. This leads to a corresponding reduction of the specific gravity, unless there be a compensatory diminution of water, or increase of albumen. The dropsy is generally distinct in the face, and swelling of the eyelids is well marked in the morning. Towards evening, if the patient be out of bed, the legs are chiefly affected. The scrotum and penis are often swollen, and sometimes the abdomen is also dropsical. There is little quickening of pulse or elevation of temperature, but a good deal of general uneasiness is experienced, with debility and pain in the loins; and dyspeptic symptoms are often present, due to gastric catarrh. Such is the usual condition at the commencement of the disease, and during the period which has been already described as the first stage. But sometimes at this stage a much more serious condition is developed—namely, suppression of urine, followed by coma or convulsions leading to a fatal result; or dropsy may increase to such an extent as of itself to cause death. Or, again, without or even with the most unfavourable symptoms, under appropriate treatment the kidneys may begin to act more freely, the urine increasing in amount and improving in characters, with consequent gradual disappearance of the dropsy, and restoration of health. Or, as often happens, the general condition improves, but a chronic albuminuria remains, and the disease passes into the second stage. The urine is then no longer bloody; the quantity is greater, though still below the normal; the specific gravity is low; there is albumen, along with tube-casts, fatty, hyaline, or mixed, partly fatty and partly hyaline. The urea is below the normal standard. The dropsy may continue, and may even gradually increase, or it may pass off and only appear when the patient is fatigued, or when he has caught cold. The general symptoms remain unchanged, except that anæmia comes on, and the patient's debility steadily increases. This course of events may pass on to a fatal result; or there may be complete, or, as is more common, merely partial recovery. In this condition the patient may linger for many months, occasionally suffering exacerbations, and he may succumb to one of them, or to one of the numerous complications to be presently described. If the patient passes into the third stage, he appears prematurely old. His urine is of natural amount or even somewhat increased in quantity, but of low specific gravity. It contains albumen and a few casts, mostly hyaline, with scattered fatty cells imbedded in them. The urea is still diminished. There is dropsy of the feet and ankles in the evenings, and slight exposure brings on more general attacks. The face is pale and pasty, and the eyelids are often œdematous. The pulse becomes hard and tense; the arteries gradually become thickened from sclerosis and atheroma; while the apex-beat of the heart passes downwards to the left side owing to hypertrophy, particularly of the left ventricle In this condition a fatal result may be induced by an acute exacerbation with general dropsy; by chronic, or, more rarely, acute uræmia; or by intercurrent attacks of inflammatory or other affections of various organs.

2. *Of the waxy disease.* The onset of this affection is gradual and insidious. A patient who has suffered from phthisis, syphilis, or other wasting malady passes an excessive quantity of urine, and finds himself obliged to rise several times during the night for micturition. The urine is pale, of low specific gravity, containing at first no albumen, subsequently only a trace, ultimately a considerable amount. The urea is little, if at all, diminished; the tube-casts are extremely few, and mostly hyaline. There is no dropsy, but evidence of concomitant waxy affections of other organs is frequently afforded. The liver is enlarged, its margin being easily felt and sharply-defined. The spleen is also increased in size. The blood is slightly altered, the white corpuscles being somewhat increased, and the red being rather flabby and ill-defined. These conditions gradually become more distinct, and the strength of the patient diminishes, partly from the disease of the kidneys and other organs, partly from the wasting diseases which have induced the degenerative changes. A case of the kind has been known to go on for nearly ten years, during which time the urine continued of the characters just described, and dropsy never appeared. At length the vital powers of the patient became depressed, head symptoms gradually supervened, and death ensued. It is not often that such an uncomplicated case is met with. More commonly the exhausting disease which led to the degeneration causes death before the waxy change has gone so far. Sometimes also intercurrent complications induce the fatal result. Clinical observation renders it probable that the kidneys, as well as the liver and spleen, may recover from their degeneration, in cases in which the causal malady has been got rid of.

3. *Of the cirrhotic disease.* The onset of this affection is extremely insidious, and it may exist for a long time without distinctly manifesting itself by symptoms. Its existence is often discovered only when dyspepsia, uræmic convulsions, or blindness from retinitis leads the patient to consult a medical man. The earliest symptoms are occasional slight albuminuria, and frequent calls to micturition during the night, the urine however not being excessive, its specific gravity being low, and the urea somewhat diminished. But when the disease has existed for some time the complexion becomes altered; the eye assumes a peculiar appearance, from œdema of the conjunctiva; the patient is subject to dyspeptic

attacks; the heart becomes hypertrophied, and the vessels sclerosed and degenerated; while there is little or no dropsy. When the disease is advanced, these changes in the circulatory organs are well-marked, and the cachectic condition becomes distinct. The occurrence of various complications, such as severe gastric catarrh, diarrhœa, anæmia, dyspnœa, bronchitis, œdema of the lungs, headache, uræmia, and the characteristic retinal affection, render the diagnosis easy. Frequently towards the end there is an increased flow of urine, of low specific gravity. This is in some cases a very prominent symptom. The disease is never recovered from, and the fatal result occurs from uræmia; from some inflammatory complication, such as pleurisy, pericarditis, bronchitis, or pneumonia; or from some result of degenerative change, as hæmorrhage from a mucous surface or into the brain.

Complications—(α) **Connected with the Abdomen and Alimentary System.**

Gastric affections are met with in all the forms of Bright's disease. Catarrh of the stomach—acute, sub-acute, and chronic—is common to them all, and is characterised by an unusual tendency to nausea and vomiting. It is especially frequent during the first stage and in acute exacerbations of the inflammatory form, and is often a chief source of suffering during the most advanced stages. It is not uncommon during the whole course of the waxy form, but is most usually met with in the cirrhotic variety. So close indeed is the relationship between them, that in the management of cases of cirrhosis regard should constantly be had to the state of the stomach, and in no case of chronic gastric catarrh should the physician neglect to enquire into the state of the urine. This affection, when complicating the early stage of the inflammatory form, often owes its origin to the same cause as the kidney-affection is due to. When complicating the later stages of the inflammatory, and any of the stages of the cirrhotic disease, the catarrh is probably a result of efforts at elimination of materials retained in the blood by the failure of the action of the kidneys. When occurring in the waxy form, it is frequently due in part to the existence of waxy degeneration of the vessels of the gastric mucous membrane. In the waxy disease we sometimes find blood mingled with the vomited matters, just as we find hæmorrhage occurring in other organs when this degeneration exists.

Catarrh of the intestine also occasionally occurs, sometimes producing an exhausting diarrhœa, especially in advanced inflammatory and cirrhotic cases; but it is along with the waxy disease that intestinal symptoms are most common. These are due to waxy degeneration, and consequent ulceration; or to ordinary tubercular disease of the intestine. Both of these affections induce diarrhœa, but there is evidence that not only may it thus occur, but that blood may also be discharged, although there be no ulceration recognisable by the naked eye.

Hepatic affections.—Functional derangements of the liver occur in the course of all the forms of Bright's disease. The chief organic changes are fatty degeneration, waxy degeneration, cirrhosis, and syphilitic affections. The first-named is not specially related to any of the forms. The waxy degeneration and the syphilitic affections are of course commonly met with as accompaniments of the waxy disease; whilst cirrhosis attends upon the cirrhotic kidney.

Ascites is often seen as a manifestation of general dropsy in the inflammatory form of Bright's disease; and sometimes this is a prominent symptom in mixed forms, when waxy liver is associated with a waxy and slightly inflammatory condition of the kidneys.

Peritonitis is occasionally the cause of death in all the forms of Bright's disease. It may result from local affections, or from the state of the blood; and may be acute, severe, and therefore obvious, or so insidious as scarcely to attract attention.

(β) **Complications connected with the Blood, or with the Lymphatic- and Blood-glands.**

The *spleen* is usually unaffected in cases of inflammatory Bright's disease, except such as prove fatal in the earliest stage, and in which the spleen is affected in common with the kidney. In the waxy and cirrhotic forms corresponding lesions are frequent in this organ.

The *lymphatic glands* are rarely altered excepting in the waxy form, in which they are sometimes the subject of the waxy degeneration, sometimes of tubercular disease, or of strumous inflammation.

The *blood* itself is altered in its chemical composition. In the inflammatory form its density is diminished, the corpuscles and albumen being deficient, while the water is correspondingly increased. The quantity of urea is above the normal. In long-standing cases of waxy disease similar changes are found; and not unfrequently there is a slight numerical increase of the white corpuscles, and flabbiness of the red blood-discs when the spleen is affected. In the cirrhotic form like alterations also occur.

Hæmorrhage is apt to occur in advanced stages, especially of the cirrhotic form. It may take place from the kidneys, or from the mucous membranes, particularly that of the nostrils. In the inflammatory affection hæmaturia is common in the early stage; in the waxy variety this symptom occasionally occurs, but rarely to a serious extent.

(γ) **Complications affecting the Circulatory system.**

Hypertrophy of the heart is almost always present in cases of advanced cirrhotic disease, and also in the advanced stages of the inflammatory affection. One may trace in patients the gradual development of this hypertrophy, advancing *pari passu* with the progress of the renal affection. It is comparatively rare in the waxy form. *Hydropericardium* is met with in some cases, as a manifestation of general dropsy. *Pericarditis* occurs as an intercurrent affection in all the forms, but especially the inflammatory and the cirrhotic. It is apt to be overlooked, owing to the absence of local pain, or from the pain being referred to the abdomen. *Endocarditis* is also frequently associated with the various forms of Bright's disease

The *arteries* are sclerosed and atheromatous in the advanced stages of the inflammatory and in the cirrhotic, but not so much in the waxy disease. In that affection the small vessels in

other parts are frequently the seat of waxy degeneration. Thickening of the arteries occurs constantly in the more advanced stages of the inflammatory and cirrhotic diseases, and is due in great part to hypertrophy of their middle coat, in lesser degree to sclerosis of the tunica intima, the tunica adventitia, and perhaps the perivascular lymphatic sheath. The *pulse* becomes tense and sustained in chronic cases, partly from the hypertrophy of the heart, partly from the changes in the capillaries and smaller arteries.

(δ) Complications connected with the Respiratory system.

Acute bronchitis is common, especially in the advanced stages of Bright's disease, and tends to pass into the chronic state. Bronchitis may originate also as a sub-acute or chronic affection. *Œdema of the lungs* is very common in advanced stages, and frequently occurs as a manifestation of general dropsy in the early, as well as in the later stages of Bright's disease. It may be very suddenly developed in cirrhotic cases, and may rapidly prove fatal. *Pneumonia* occurs sometimes as a cause of inflammatory Bright's disease, sometimes as a consequence of exposure to cold during the course of chronic cases. *Phthisis* in its various forms is found causally associated with these renal affections, frequently with the waxy, and more rarely with the inflammatory form. It usually proves fatal while the renal malady is yet in its early stage. *Hydrothorax*, acute or chronic, is often seen in dropsical cases. *Pleurisy* occasionally occurs with all the forms of Bright's disease, and may be due to the state of the blood; or, as seems more likely, to increased susceptibility to inflammatory changes, which results from the lowered vitality of the organism. *Dyspnœa* is frequently met with in the inflammatory and cirrhotic forms of the disease, and may be independent of any local lesion, being probably a result of uræmic poisoning. *Œdema glottidis* is apt to occur in inflammatory cases, when even a slight laryngitis has from any cause been brought on.

(ε) Complications affecting the Skin and Subcutaneous tissues.

Dropsy, in the form of anasarca, is almost constantly present in the early stage, and during exacerbations of the inflammatory form. It can scarcely be said to occur in uncomplicated waxy and cirrhotic cases. *Eczema* is occasionally troublesome in chronic cases. *Erysipelas* is met with now and then, always constituting a serious addition to the other malady.

(ζ) Complications affecting the Urinary organs.

The chief of these is scrofulous disease of the kidney, and more rarely of the bladder and prostate. They occasionally occur along with the waxy affection.

(η) Complications affecting the Nervous system and Special senses.

Uræmic blindness may occur, which is sudden and usually temporary, being unaccompanied by any lesion recognisable by the ophthalmoscope. It is generally met with in advanced cirrhotic and inflammatory cases. *Retinitis albuminurica* is a peculiar and characteristic inflammation of the connective tissue of the retina, leading to the formation of white patches and lines, with fatty degeneration. With it are also frequently associated minute hæmorrhages into the substance of the retina. This occurs by far the most frequently in cirrhosis. It is often also seen in the advanced stages of the inflammatory form, and is rarely recovered from except in the case of pregnant women, in whom it seems apt to occur as a passing condition.

Uræmia includes a group of the most striking symptoms of Bright's disease. It may occur at the commencement of the acute inflammatory affection, or in its later stages, or in the chronic forms. The condition is, however, rare in the purely waxy disease, but common in the cirrhotic. There are several types of uræmia, of which the most important are:—(*a*) Sudden acute convulsions, followed by coma and death; (*b*) Gradually advancing torpor, passing at last into coma. The clinical features of these and minor varieties are described, and the hypotheses as to their origin discussed, in the article Uræmia.

Headache is frequently complained of by patients suffering from Bright's disease. *Apoplexy* from hemorrhage into the substance of the brain is common in the later stages of the inflammatory and cirrhotic diseases. It is due partly to the degenerated state of the vessels, and partly to the increased pressure resulting from cardiac hypertrophy.

(θ) Complications affecting the Locomotory system.

Of these the only ones of importance are *disease of bone*, which has been already referred to as a causal complication in waxy cases; and *gouty affections*, which have been mentioned in connexion with the cirrhotic disease.

Diagnosis. **(*a*) Of Bright's Disease from other affections.** From *passive congestion of the kidneys* due to cardiac disease these maladies are distinguished by the general condition of the patient; the absence of cardiac disease, and of congestion in other organs; and the characters of the urine. In heart-affections the urine is generally scanty, high-coloured, not of low specific gravity. It may contain albumin, and deposits urates, but rarely blood, renal epithelium or tube-casts. Hyaline casts may be present, but never in any large quantity. The presence of epithelial and fatty casts, or marked diminution of the amount of urea in any case, proves at least the co-existence of actual inflammation of the kidney. From *paroxysmal hæmatinuria* and *albuminuria*, Bright's diseases are distinguished by the abrupt commencement and brief duration of these maladies; by the marked nervous symptoms, with gastric catarrh, and sometimes slight jaundice; and by the absence of dropsy. In hæmatinuria also the condition of the urine is very distinctive; the dark-red colour being due, not to blood-corpuscles, but to granular pigment, the deposit consisting mostly of this material and of hyaline casts. In paroxysmal albuminuria again the amount of albumin is very large, and the number of tube-casts extraordinary. *Hæmaturia*, with tendency to suppression of urine, is distinguished from Bright's disease by the small proportion of epithelial tube-casts, and in some cases by the complete absence of casts. There may be a question whether the case is one of hæmaturia or of commencing acute inflam-

matory Bright's disease; or again whether it is one of a chronic affection, cirrhotic or cystic, in which hemorrhage has come on. The cases in which Bright's disease simulates hæmaturia are generally the sequelæ of scarlatina or diphtheria; and, therefore, even when these diseases have been overlooked, the presence of desquamation or of paralysis may afford a clue; but the peculiar reddish-brown deposit rich in cells and in epithelial tube-casts, which occurs in Bright's disease, makes the case clearer even when, as often happens, there is no dropsy, or when, as we sometimes see, the albumen is not coagulated by heat or by nitric acid. Again, when the question is between simple hæmaturia and hæmaturia with cirrhosis or cystic disease, the evidence afforded by the tube-casts is not important, but the hypertrophy of the heart, the thickening of the arteries, the character of the pulse, the albuminuric retinitis, the low specific gravity of the urine and the small amount of urea which it contains, as well as the tendency to hæmorrhage from other sources, afford evidence of the presence of the chronic organic disease.

Slight *pyelitis*, with or without renal calculus or gravel, may simulate Bright's disease, but the history of pain, the presence of mucus and pus-corpuscles in the urine, of oxalate of lime or uric acid, with the full proportion of urea, and the absence of tube-casts, indicate the nature of the case.

(β) **Of the different forms of Bright's disease from each other.** The discrimination presents in simple cases little or no difficulty. The points to be attended to are the history of the patient; the amount and characters of the urine; the presence or absence of dropsy; and the nature of the complications. The previous occurrence of exanthematic affections, of chronic wasting disease, or of intemperance, gout, or plumbism, would afford some obvious indications. The mode of origin and progress of the malady is very important. Thus a case commencing actually with dropsy and diminution of urine is inflammatory; one of less acute character with polyuria is waxy; and one commencing insidiously, with no marked symptom until perhaps convulsions or dimness of vision appeared, would be an example of cirrhosis. The leading symptoms of the *inflammatory* variety are diminution of urine; an abundance of albumin and of epithelial tube-casts, with diminution of urea; and marked dropsy. Of the *waxy* kidney, the prominent features are early and persistent polyuria; waxy degeneration of other organs; and absence of dropsy. In the *cirrhotic* form the insidious commencement; the gradual development of vascular and cardiac changes; with in the later stages, in many cases, polyuria, are the most important phenomena. Other indications may be gathered from the complications of each form of Bright's disease. It must be remembered that mixed forms frequently occur, and that in these careful inquiry and patient investigation are essential to the establishing of a correct diagnosis.

Prognosis.—The prognosis, though always grave, varies in the different forms of Bright's disease. In the *inflammatory* affection it is least unfavourable, although this affection is the most immediately dangerous. During its first stage we may always hope for complete recovery, especially in cases of post-scarlatinal origin. Of forty-one successive cases treated by the writer in the Royal Infirmary, Edinburgh, twenty-two recovered entirely, while twelve died, and seven passed into the second stage. If this be the proportion in hospital cases, which are generally sent there on account of their severity, and are rarely sent in the earliest stages of the disease, it is obvious that the proportion of recoveries must be much larger in private practice. When the disease reaches the second stage, the prognosis is more grave, complete recovery being rare, and death sometimes taking place from sudden or gradual increase of the symptoms, or from intercurrent affections. But even in this condition complete recovery may be brought about, and in many cases the patient goes on for long periods, presenting few symptoms to attract attention. In the third stage the prognosis is entirely unfavourable, the system becoming steadily more deteriorated, and death occurring, either from the direct effects of the disease, or from complications. Still, even such cases often go on for long periods, if placed under favourable hygienic and therapeutic conditions.

In the *waxy* form the prognosis must almost always be unfavourable, although the malady is never rapidly fatal. On the contrary, its course is always chronic, in some cases extending over five or even ten years. The fatal result is due to complications more frequently than to the disease itself. Recovery probably sometimes takes place, but only when the cause of the degeneration is removed, and the general surroundings of the patient are favourable. It is certain that the liver and spleen may to a large extent recover from waxy disease, and recovery has been witnessed in cases which presented all the symptoms pointing to implication of the kidneys.

In the *cirrhotic* form the prognosis is very unfavourable, but the progress of the disease is so slow that it is often unadvisable to say anything about it to the patient, as the fatal result may be long deferred. It must, however, be kept in view that the disease may be far advanced before its existence is made out.

Among the symptoms and complications which are fitted to cause special alarm when they occur in connection with any of the forms of Bright's disease, we must recognise suppression or great diminution of urine, especially if accompanied by nervous phenomena or general dropsy; uræmia, more particularly its chronic form; and acute inflammations and hæmorrhages. Retinitis albuminurica is always a very serious symptom, except when it occurs in pregnant women.

Treatment. (1) Of the *inflammatory form*. The objects to be kept in view are to arrest the inflammatory action; to remove the inflammatory products from the kidneys; and to obviate the deleterious effects upon the system generally of the accumulation of effete materials. One remedy or plan of treatment may meet more than one of these indications. The most useful means of subduing the inflammatory action, or at least the congestion which attends it, are local blood letting by means of leeches or wet cups; dry

cupping; and the application of hot fomentations, poultices, and counter-irritants. Bloodletting is only serviceable in the early stage of the disease, or when severe exacerbations with suppression of urine occur. Poultices or hot fomentations are of use in the same circumstances. Counter-irritation is helpful in the more chronic conditions. Iodine and croton oil inunction are the best fitted for its induction, whilst cantharides must be avoided on account of its tendency to irritate the kidneys.

The removal of the inflammatory products which block up the uriniferous tubules is of the utmost importance, and is in the great majority of cases best effected by means of diuretics. Water and diluent drinks are the safest, and are sometimes found sufficient. The medicinal diuretics must be non-irritating, and the best of all is digitalis, which may be given safely even when the urine is bloody. It may be administered in the form of infusion, tincture, or made up into a pill. Of the infusion from a drachm to an ounce, of the tincture from five to thirty minims, of the powder from half-a-grain to two grains, should be given three times a day. The infusion or the tincture may be combined with spirit of nitrous ether, with acetate of potash, or with tincture of perchloride of iron. Its action is often favoured by the addition of squill and carbonate of ammonia. Sometimes it happens that diuretics do not suit the case, the urine becoming diminished and more bloody under their use; and in other cases the symptoms become so urgent that death might take place before there would be time for diuretics to act. In either of these conditions relief must be obtained by the bowels or skin. The bowels are best acted upon by means of from twenty grains to a drachm of the compound jalap powder, or one-twentieth to half-a-grain of elaterium. The action of the skin may be excited by the use of acetate of ammonia or antimony; but pilocarpine, hot air, vapour-baths, and the wet pack are the most efficient agents. Throughout the whole course of the disease constipation should be avoided, and the action of the skin encouraged. When the disease has become less acute, and certainly when dropsy persists during the second stage, other diuretics are of the utmost value, particularly the acid tartrate of potash, the oil of juniper, and the decoction of broom. Iron must be assiduously administered, to make up for the waste of the materials of the blood. Gallic acid, ergot, and belladonna have all been praised as tending to diminish the discharge of albumin resulting from a persistent chronic inflammation of the tubules. The treatment of special symptoms and complications will be considered after indicating the general management of the other varieties of Bright's disease.

The diet during the earliest stages should be easily assimilable, and not too rich in nitrogenous elements. Milk is, as a rule, well borne. Some practitioners laud skimmed milk as an unfailing remedy in the disease. It is a good diuretic, and, when it suits the stomach, a good article of diet, but possesses no other therapeutical virtue. In the more chronic stages the food should be of the most nourishing kind, and a moderate allowance of stimulants may be needed.

(2) In the treatment of the *waxy form*, the most important indication is to seek to remove the cause of the degeneration, if still existing. If there be disease of bone or chronic abscess it must, if possible, be cured; constitutional syphilis must be combated by appropriate remedies. The tincture of perchloride of iron, quinine, nux vomica, and such combinations as Easton's syrup of the phosphates, are useful. The patient must also have good food, and should lead an easy life.

(3) In the *cirrhotic form* it is probable that no remedy we at present possess can influence the pathological process, although arsenic and alkaline remedies, and particularly iodide of potassium, enjoy a certain reputation. It is of course the duty of the skilful physician to obviate the results of the morbid process. It is obviously of great importance to avoid the causes of the disease. Lead-poisoning should be avoided; the gouty tendency kept in check; and the abuse of alcohol forbidden.

(4) In the management of the *combined forms* of Bright's disease these plans of treatment must be conjoined according to circumstances, but, on the whole, treatment is much less successful than in the simple cases. In the combined waxy and inflammatory affection, for instance, it is not uncommon for dropsy to persist, although the diuretics bring the urine up to or above the natural standard.

(5) With regard to the special *symptoms* and *complications* of Bright's disease, the sickness and vomiting are best relieved by counter-irritation over the stomach; and by giving ice, milk, and hydrocyanic acid internally. These symptoms are, however, often very intractable. Diarrhœa must sometimes be let alone; at other times it must be treated by means of astringents or sedatives, either administered by the mouth or as enema or suppository. Ascites must be treated as a manifestation of dropsy, and occasionally the abdomen requires tapping. Peritonitis must be combated by hot fomentations and opium, but the latter requires great care in its administration. All through the disease in all its forms hæmatic tonics are demanded; iron in some form should be constantly administered. For hæmorrhages the pernitrate of iron, local astringents, ergot and ergotine, gallic acid, or acetate of lead must be tried in various combinations. The best results have followed the use of ergotine in 3- to 5-grain doses injected subcutaneously. The irritating effects sometimes observed after the subcutaneous injection of ergotine may often be obviated by boiling the solution, or by the addition of a minute quantity of salicylic acid. Hydropericardium and pericarditis must be treated in the usual way. The vessels and the heart are not amenable to treatment. Bronchial catarrh must be carefully attended to, by the avoidance of exposure to cold; by the application of counter-irritation externally; and by the internal administration of expectorants. Œdema of the lungs must be treated by counter-irritants, and by remedies fitted to reduce the general dropsy. Pneumonia, phthisis, and pleurisy must be treated on ordinary principles. Hydrothorax may demand paracentesis. General dropsy is one of the most important complications, and should be combated by means of

diuretics, purgatives, and diaphoretics; in many cases puncture of the œdematous parts is demanded. When puncture has been determined upon, precautions must be taken to avoid inflammation. Eczema and erysipelas, when they occur, should be dealt with according to the principles of the art. Headache is relieved in different cases by iron, by hot or cold applications to the head, by quinine, or by inhalation of a few drops of nitrite of amyl. When uræmia occurs in acute inflammatory conditions, or with suppression of urine, dry-cupping or wet-cupping over the renal regions should be tried, along with free purgation and hot-air baths and, especially in puerperal cases, general blood-letting. Bromide of potassium should be given in drachm doses, and if convulsions be severe, the patient must be kept under the influence of chloroform. In the more chronic and gradually advancing form of uræmia, counter-irritation at the back of the neck and over the scalp sometimes appears to be useful. But treatment is not so often of advantage in this as in the other form. In the eye-affections, iodide of potassium enjoys some reputation. Hæmorrhagic apoplexy demands no special measures for its treatment.

T. Grainger Stewart.

BROMISM.—Definition.—Bromism is the term applied to the morbid effects produced by the administration of the salts of bromine under certain circumstances.

Description. — The effect of the salts of bromine, when administered in medicinal doses, is to reduce nervous activity; and thus, with a certain amount of anæsthetic influence, to promote rest and sleep. When such doses have been long continued, or in certain idiosyncrasies, or when excessive doses are administered, results are produced which constitute a state of disease, and to this condition the term 'bromism' is applied. These results are manifested on the brain and spinal cord; on the skin; on the mucous membranes and glandular structures; and on the organs of circulation and respiration.

1. *On the Brain and Spinal Cord.*—When the therapeutic action intended to be obtained from the use of a salt of bromine is exceeded, the quiet or sleep becomes more pronounced, and there is more or less constant somnolence; the memory becomes impaired, words being forgotten or misplaced, whilst written and spoken language is confused, the tongue is tremulous, and speech is difficult. The gait becomes feeble and staggering, with inability to control movement, and somewhat resembles the condition observed in locomotive ataxy. The special senses—sight, hearing, taste, and touch—are impaired: reflex excitability is diminished, and this is especially observed in the fauces, occasionally to such an extent as to cause difficulty in swallowing. Sexual feelings are diminished or altogether suppressed. The general aspect of a case of well-marked bromism much resembles one of senile imbecility.

2. *On the Skin.*—A very frequent result of the internal use of the bromides is a follicular eruption of the skin, closely resembling acne, which is generally situated on the face, chest, and shoulders. When the use of the drug is continued, the acne becomes aggravated, and boils appear. A more rare form of skin-disease similarly caused has been described by Dr. Cholmeley, Mr. Hutchinson, and M. Voisin. This disease appears as vesicles, which become aggregated into clusters or patches. These proceed to suppuration, and are soon followed by scabbing, their base being slightly raised, hard, sometimes ulcerated, and surrounded by a red areola. In a later stage the eruption presents the appearance of dusky red stains. It has been observed more especially on the limbs and head. Eruptions having more or less the characters of erythema and of eczema have also been described as following the use of these agents.

3. *On the Mucous Membranes and Glandular Structures.*—Dryness of the mouth and tongue is often experienced in bromism; but in some cases there is said to be an increased flow of saliva. Nausea, flatulence, eructations having a saline taste, heat and fulness at the epigastrium, and occasionally gastric catarrh and diarrhœa, have been observed; it is said that acute enteritis and even a typhoid condition have occurred.

4. *On the Organs of Circulation and Respiration.*—The salts of bromine are said to produce contraction of the capillaries. The skin may present a peculiar pallor, and the extremities feel cold. The action of the heart is rendered slower and weaker; and may even cease altogether, under the continued operation of these drugs. The action on the respiratory organs is similar to that upon the heart. It has been observed that bromine—recognised by its peculiar odour in the expired air—is eliminated from the respiratory mucous membrane. Bronchial catarrh occurs, and instances are recorded in which pneumonia is said to have followed and proved fatal.

It must be remembered that, although it has been thought desirable to discuss separately here the effect of these drugs on the several systems, these effects are combined in various degrees. In some cases the affection of the skin is alone noticeable; in others, that of the nervous system; while in a third class there is produced a combination more or less of all the phenomena, constituting what may be called a *cachexia*. In such cases we find loss of flesh, strength, colour, and mental power; paralysis of the muscles; loss of reflex and general sensibility and of the functions of the special senses; complete apathy and general prostration, the countenance having a semi-idiotic expression; coldness of the extremities; and gradual failure of the heart's action.

Pathology.—The condition just described is but the extreme effect of the ordinary physiological action of the salts of bromine. This condition may be due either to idiosyncrasy—that is, to undue susceptibility on the part of the individual—or to the administration of large quantities of the drug, either in medicinal doses for a long period, or in excessive doses administered within a short time. The individual susceptibility may depend upon the want of capability to eliminate the drug; on the general state of health; or on the presence of a disease

which resists its action. Under these circumstances, as well as in the presence of certain modifying influences, such as the action of other remedial agents simultaneously administered, it is difficult to fix upon the amount of a bromine salt capable of producing morbid symptoms in any given individual. The writer has seen a nightly dose of ten grains of bromide of potassium, continued for some weeks, produce marked somnolence during the day, and impairment of memory; whilst it has required the enormous doses of 200 or 300 grains a day, which seem to be administered on the Continent, to produce the extreme effects above described. The rapidity with which these effects are produced, constituting the *acute* and *chronic* forms of bromism, will depend on the amount and frequency of the dose, and on the susceptibility of the individual. The effect of a sudden considerable increase in the dose has been observed by the writer in a case which first directed his attention to the subject of bromism in 1872. This case he saw in consultation with Mr. Alfred Burton. Half-drachm doses of bromide of potassium had been taken twice a day for several weeks, when by mistake the quantity of the drug was doubled; then, after three days, symptoms closely resembling senile imbecility were rapidly developed.

Diagnosis.—Recognising the value of the bromides, and the frequency with which they are used, it is extremely important that the peculiar results which they are capable of producing should be borne in mind; for if they are not recognised in time, and if the use of the drugs be persisted in, disastrous effects which might otherwise be avoided will follow. Without going into details of diagnosis, it will probably be sufficient to point out the necessity for remembering that the symptoms which have been described above can be produced by the use of bromides; and that when such a combination of symptoms does occur during their use, it is highly probable, in the absence of disease capable of accounting for them, that the symptoms have originated from the operation of those agents.

Treatment.—This consists in stopping the use of the drug, and hastening its elimination by promoting the action of the kidneys and other excreting organs. It is said that arsenic in combination acts as a preventive of the eruptions.

The above description refers to the effects of bromide of potassium; but like effects are produced by other salts of bromine, though to what extent by each has not yet been ascertained.

R. Quain, M.D.

BROMIDROSIS (*βρῶμος*, a stench; and *ἱδρῶς*, sweat). A term for fetid perspiration. *See* Perspiration, Disorders of.

BRONCHI, Diseases of.—The diseases of the bronchi may be discussed in the following order:—1. Acute inflammation; 2. Chronic inflammation; 3. Plastic inflammation; 4. Dilatation; 5. Narrowing or obstruction; 6. Cancer.

1. Acute Inflammation — Acute Bronchitis.—Acute Bronchial Catarrh.

Definition.—An acute inflammation or congestion, general or partial, of the bronchial tubes

Ætiology.—The causes of acute bronchitis may be classed as (*a*) *predisposing* and (*b*) *exciting*.

(*a*) Of the *predisposing* causes age is one of the most important. The disease is indeed confined to no period of life, but it is most frequently met with in the young and the old, and in these subjects it assumes its most serious characters. The imperfect development of the infant, and the diminished vitality of the aged, seem to render them especially liable to attacks of bronchitis, and to make the disease exceptionally fatal in them. Sex appears to have no influence as a predisposing cause. The habits of life have an important influence in the causation of bronchitis. The practice of living in heated rooms, especially where gas is largely consumed, and of breathing the vitiated atmosphere produced by the assemblage of large numbers of persons in apartments, is undoubtedly a fertile predisposing, as well as exciting, cause of the complaint; so also is the practice of keeping children too much within doors on the one hand, or, on the other, of exposing them to inclement weather when insufficiently clad. Temperament can scarcely be considered a predisposing cause, but the state of the general health exercises a powerful influence. A weakly constitution, or one weakened by overwork, improper food, &c., predisposes to bronchitis; whilst such affections as Bright's disease, gout, and diseases of the heart, alike favour its occurrence. Again, certain occupations are favourable to the development of bronchitis. Independently of the fact that living or working in heated and confined rooms predisposes to the disease, such occupations as lead to the inhalation of irritating particles, as those of steel, cotton, &c., give rise to it. The climate most favourable to the production of bronchitis is probably that which is at the same time both cold and damp, and where sudden variations of temperature occur. The seasons of the year in which it prevails most are the late autumn, the winter, and the early spring.

(*b*) *Exciting causes.*—Although undoubtedly cold directly applied to the surface of the body is in a large number of cases the exciting cause of bronchial inflammation, still the transition from cold to heat—passing from a cold atmosphere to a heated one—is a large factor of the disease. There can be little doubt that bronchitis is often produced directly by the effects of heated and vitiated air on the bronchial membrane, and on the system at large; and that in the latter instance the affection is merely a local manifestation of a general influence. Bronchitis may also be caused by the direct action of irritants contained in the air—as irritant vapours, minute particles of steel, cotton, or ipecacuanha, and the emanations (pollen) from flowering plants. Again, morbid conditions of the blood, the result of specific febrile affections, act as exciting causes of the disease; as do also the poison of syphilis, and the altered condition of the blood produced by gout. Bronchitis is, moreover, a constant accompaniment of influenza.

Anatomical Characters.—The mucous membrane is mainly affected in acute bronchitis, but morbid changes may be produced in the deeper structures. The mucous membrane is red—the

redness being arborescent, streaked, or mottled, but not usually spread uniformly over a large surface. The injected condition of the membrane does not, as a rule, extend into the finer bronchial tubes, but in some cases where there have been frequent attacks of inflammation, the smallest bronchi have a red appearance. The membrane is sometimes thickened and soft, but ulceration is very rare. The tubes are generally found more or less filled with secretion, either frothy mucus, muco-pus, or even actual pus. Sometimes the secretion is very abundant, filling all the tubes. Fibrinous masses are occasionally met with, which may form casts of the tubes. Collapse of portions of lung-substance—lobulettes or whole lobules of the lungs—is not unfrequently found, as are also patches of lobular pneumonia. The venous system and the right side of the heart are overloaded, and the blood is dark. In many cases fibrinous deposits are found in the cavities and great vessels of the heart.

In speaking of the pathology of bronchitis, it is necessary to refer to the distribution of the bronchial blood-vessels. The bronchial arteries when they have fairly entered the lungs have no accompanying veins. The so-called bronchial veins are some small vessels which return the blood supplied to the structures about the roots of the lungs. The blood which is supplied to the bronchial tubes, when they have commenced their divisions, passes into radicles of pulmonary veins, and is returned directly to the left side of the heart. The question whether there is a communication between the bronchial arteries and the pulmonary artery, is still *sub judice*. If such communication exist, it is only slight. The blood of the bronchial arteries, after supplying the mucous membrane and other structures of the tubes, passes, either wholly or in very large part, to the left side of the heart, not having circulated through the aërating portion of the lungs. The circumstances of this anatomical arrangement are most important in a practical point of view. Anything which embarrasses the circulation on the left side of the heart—such as mitral regurgitation—must necessarily cause a very loaded condition of the bronchial vessels; and all physicians are familiar with the form of bronchitis which is so common in these cardiac affections. The congested mucous membrane, and the profuse bronchial secretion, are the result of the direct impediment to its circulation which the blood meets with, from passing at once into vessels which go straight to the left side of the heart. The relief often afforded in this form of bronchitis by the exhibition of digitalis, is explained by the circumstance above referred to.

Symptoms.—The symptoms of acute bronchitis vary according as the larger or smaller tubes are affected. The disease attacks, first, the larger and medium-sized tubes; and, secondly, the smaller ones. To this latter form of the affection the name of *capillary bronchitis* has been given.

1. Acute bronchitis of the *larger tubes*. The attack is usually ushered in by symptoms of catarrh,—sneezing, lachrymation, a sense of fulness about the nose and eyes, with frontal headache; the throat becomes dry and sore, and then increased secretion sets in; the follicles at the back of the pharynx become enlarged; the upper part of the larynx is often involved, there being slight hoarseness; and the affection gradually creeps down into the bronchial tubes. The disease is not ushered in by decided rigors, but chills and sometimes shiverings are experienced; the pulse is not much affected, but its frequency is increased in some cases; there is a general sense of malaise, as well as a want of energy. When the disease has set in fully certain local symptoms are found. More or less pain is felt behind and above the sternum; the sensation is increased by a deep inspiration; the pain shoots at times over the chest in the direction of the larger bronchial tubes; and there is a tickling or unpleasant irritation felt behind the sternum, which gives rise to cough. Dyspnœa is not a marked feature of this form of bronchitis; it exists, however, sometimes; and in the most severe cases a sense of oppression, weight, and tightness about the chest is experienced. Cough is one of the earliest and most prominent symptoms; it is at first dry, and there is usually at this period some hoarseness. The cough is paroxysmal, and often very violent; it becomes attended with expectoration as the disease progresses. This varies at different stages of the affection; at first watery and frothy, and almost transparent, it becomes as the disease progresses more consistent, viscid, and opaque, passing through the stages of mucus to muco-pus and pus; it is sometimes distinctly nummulated. Small streaks of blood are occasionally seen mixed with the sputa. Examined under the microscope the sputa are found in the early stages of the disease to contain epithelial cells from the mucous membrane; and, later, many of the so-called exudation-corpuscles, molecular and granular matter, pus-cells, and occasionally blood-discs.

In the milder cases of this form of bronchitis there is but little general disturbance; and even in the more severe cases the febrile reaction is not usually very great. The pulse rises a little, but does not become very frequent; the temperature rarely becomes high; there is in many cases but little interference with the appetite. A general feeling of depression, which in some cases is very marked, is usually experienced.

2. Acute bronchitis of the *smaller tubes—Capillary bronchitis*. This is a very formidable disease. It attacks the finer bronchial tubes, and probably extends to their smallest ramifications. Its symptoms are very grave. Some of the worst cases of capillary bronchitis are met with in connexion with emphysema of the lungs. It may be an extension of inflammation from the larger tubes; or the capillary tubes may be attacked simultaneously with the larger ones, or alone. The early symptoms are more severe than those of ordinary bronchitis, and rigors are more common. Dyspnœa is marked; it may vary from mere rapid respiration to constant or paroxysmal orthopnœa. The respirations may rise to fifty in a minute. Cough is almost continuous, at times becoming very violent and most distressing. Expectoration is attended with difficulty. The sputa soon become very abundant, and rapidly assume a purulent character; or they are very viscid and ropy.

The general symptoms are very severe. The

fever is high—the temperature reaching to 103° Fahr. and upwards; and the pulse is frequent, rising to 120 or 140. The temperature rarely attains the height which characterises acute tuberculosis or pneumonia. There are often profuse perspirations, and in some cases excessive debility is felt. If the disease progresses unfavourably, symptoms of very imperfect aëration of the blood come on. The face becomes turgid and bloated, the lips and ears get livid, the veins are distended, the temperature falls, cold clammy perspirations break out, the pulse becomes very small and rapid, delirium supervenes, the respiration is shallow and catching, and the patient dies of apnœa, and from the presence of fibrinous clots in the heart and great blood-vessels.

Physical Signs.—The physical signs of both forms of acute bronchitis may be referred to together. Inspection reveals little of practical value in simple bronchitis. The chest-form is not altered. In severe cases the abdominal movements are in excess. The costal movements are frequently those of elevation rather than expansion. In extreme cases the lower end of the sternum and the connected cartilages sink with inspiration; while the expiration-movements are slow, laboured, and inefficient. If the hand is applied to the chest, rhonchal fremitus may be often felt, sometimes over a large area. The percussion-sound may be somewhat exaggerated from over-distension of the lungs, especially in children; not appreciably altered; or deficient in resonance, owing to the accumulation of secretion at the bases of the lungs, to œdema or congestion (as in typhoid fever), or to pulmonary collapse. In young children a sound resembling the cracked-pot sound may be occasionally produced, variable in site. The sounds heard in auscultation vary according to the stage of the disease. The breath-sounds are loud when the tubes are free; when the latter are plugged by secretion, they often become feeble or even totally suppressed, from closure of a tube leading to a portion of the lung. The adventitious sounds of bronchitis include the various rhonchi, dry or moist: the dry rhonchi are heard in the early stages of the disease for the most part, but when once secretion has set in, the moist rhonchi or râles are more or less extensively heard, depending for their character on the size of the tubes which are the seat of inflammation. Thus they are called *mucous* when produced in the large tubes, *sub-mucous* and *sub-crepitant* when produced in the finer ones; the latter term being used to characterise the râles of capillary bronchitis. When the large bronchial tubes are filled with a secretion which is not viscid, the sounds may have a rattling character. The various rhonchi may be heard over different parts of the lungs at the same time, according to the seat and stage of the bronchitis. In capillary bronchitis sub-crepitant râles, accompanying inspiration and expiration, are abundantly heard towards the bases of both lungs especially. As a rule there is no displacement of organs in bronchitis, but the diaphragm is sometimes depressed from great distension of the lungs, and the heart is occasionally displaced towards the right.

Diagnosis.—The diagnosis of acute bronchitis, except in a few instances, presents no great difficulty. In the early stages of whooping-cough it is impossible to decide whether the case is one of simple bronchitis or not, but subsequently the paroxysmal character of the cough settles the point. In some cases of bronchitis occurring in children the breathing may resemble that of croup, but here the presence of catarrh; the wheezing nature of the respiration; the absence of much fever; the characters of the sputa obtained by wiping the back of the tongue, and its freedom from membranous shreds; and the physical examination of the chest indicating the presence of rhonchi, will be sufficient to establish a diagnosis. From laryngitis the discrimination is not difficult.

Pneumonia may generally be easily diagnosed from capillary bronchitis, with which form it can perhaps be alone confounded. Capillary bronchitis is not ushered in, as pneumonia usually is, by a well-marked and prolonged rigor; the general febrile disturbance is less, and the temperature not so high; moreover the absence of dulness on percussion, and of increased vocal resonance and fremitus will aid in the differentiation. From lobular pneumonia in children the diagnosis is not always easy. In this disease there is often no dulness to be perceived on percussion; whilst, on the other hand, in bronchitis dulness may exist from pulmonary collapse.

The diagnosis of capillary bronchitis from acute phthisis often presents difficulties. The main points to be relied on, independently of the family history, which may aid, are that in capillary bronchitis the fever is less and the temperature lower; signs of apnœa soon come on; and there is free expectoration of muco-purulent matter. In one form of acute phthisis there is evidence of pneumonic consolidation, followed by signs of the formation of cavities. In the miliary tubercular form there are in many cases scarcely any physical signs except râles, most marked at the apices of the lungs.

Prognosis, Duration, Termination, and Mortality.—The prognosis in an ordinary case of bronchitis is favourable, but when the disease occurs in the very young or the aged the prognosis should always be guarded. In the milder forms the affection may last only a few days, or two or three weeks. Severe cases are more protracted. The disease may terminate in perfect recovery, in death, or by passing into the chronic form. It may be the starting point of emphysema of the lungs, or of certain forms of phthisis. The mortality is much influenced (1), by age, being greatest in the very young and the very old; (2), by the previous state of health, which, if lowered by any circumstances, will render recovery more doubtful; (3), by the extent of the inflammation, especially when the disease is of the capillary form; (4), by the existence or non-existence of any organic disease of the heart, lungs, or kidneys; (5), by the disease being epidemic or otherwise; and, lastly, by the time the case has come under treatment, whether early or late.

Treatment.—In the treatment of bronchitis regard must be had to the constitutional condition of the patient. Care must be taken to ascertain whether the disease is secondary to

some organic affection; or the result of mechanical irritation, of the presence of gout or rheumatism in the system, or of influenza; or whether it arises idiopathically. The treatment of the disease as a primary affection will be considered first.

In an ordinary case of acute bronchitis it is very desirable to keep the patient confined to his room and, if the case is at all severe, to his bed. The temperature of the apartment should be maintained at from 60° to 65° Fahr. A higher temperature than this is generally not favourable to the progress of the case. In the early stages of the attack it is well to allow the air of the room to be more or less saturated with steam. A free action of the skin should be promoted; and for this purpose warm drinks, with or without some form of alcohol or some diaphoretic medicine, may be given; or a hot-air bath may be used in bed. Great relief is often experienced from the application of a large mustard or mustard and linseed-meal poultice to the chest; and it is well, if mustard is applied first, to apply immediately afterwards a large hot linseed-meal poultice, to be renewed every few hours. This constant application of warmth and moisture to the chest is often productive of very great relief to the symptoms.

Cases of acute bronchitis do not require venesection, nor is the application of leeches often, even if ever, called for. Severe counter-irritation is moreover to be prohibited. It is generally desirable to act on the bowels, and a mercurial, followed by a saline purgative, will often be of great service. In the old and debilitated, as also in the young, all lowering treatment must, however, be avoided. In the early stages of the affection, before secretion has commenced, and when the mucous membrane is dry and the cough hard, diaphoretics with ipecacuanha may often be given with advantage; but as soon as secretion is fairly established, carbonate of ammonia, spirits of chloroform, ether, cascarilla, senega, or such-like drugs should be administered. Indeed in almost every stage of bronchitis carbonate of ammonia is one of the most valuable remedies we possess. Care should be exercised, especially with the aged, that nothing should be given which will so nauseate as to prevent food being taken. In the exhibition of medicines to alleviate the cough, regard must be had to the condition of the patient and the stage of the disease. Opium in all its forms should be given with caution, especially in the young and old. It no doubt often succeeds in checking cough, but in doing so it also checks expectoration, and causes an accumulation in the bronchial tubes, which sometimes becomes very dangerous to life. Chloral in small doses is often of great use for relieving cough, and it may be combined with oxymel of squills. It has also a good effect in allaying spasm of the tubes, if this exist. In some cases of bronchitis the question of procuring sleep becomes an important one. Opium in its various forms is generally inadmissible, in consequence of its tendency to increase the condition of apnœa; but chloral may be given with safety, and the recovery of a patient may sometimes be dated from the sleep which this agent procures.

In reference to the exhibition of alcoholic stimulants, except in the early stages, and in certain cases dependent on a gouty or rheumatic condition, they should usually be given in smaller or larger quantities. They increase expectorating power, and ward off the tendency to apnœa. In the old they are especially called for, and, together with carbonate of ammonia, should form the main therapeutic agents to be relied on. In the treatment of capillary bronchitis, ammonia and alcoholic stimulants should be exhibited from the commencement, and the quantity must depend on the symptoms of each case. There is one source of danger in capillary bronchitis which should always be borne in mind, viz., the formation of fibrinous clots in the heart and great blood-vessels. These deposits become the proximate cause of death in many cases, and they are especially liable to form when there is emphysema of the lungs. Their presence may often be diagnosed during life from the respiration becoming very rapid, shallow, and laboured: the pulse being quick, weak, and small, although the heart may at the same time be felt beating vigorously; the voice becoming feeble; and the mental faculties seriously impaired. After death a large portion of the cavities of the heart may be found occupied by these deposits, the calibre of the pulmonary artery and aorta being also materially diminished by them.

In many cases of bronchitis, when the acute symptoms have passed off but the secretion continues profuse, as well as in those cases called bronchorrhœa, the exhibition of iron is often of great service. It seems to give tone to the relaxed capillaries of the mucous membrane, and to diminish the secretion. It may be given in combination with carbonate of ammonia, in the form of the ammonio-citrate; or the tincture of the perchloride with ether or spirits of chloroform may be employed, or the ethereal tincture of the acetate (Ph. Ger.), which is a very valuable preparation in some cases.

Inhalations are useful for allaying cough in the earlier stages of the affection, or for the relief of spasm. In some cases of severe bronchitis where apnœa has been threatened, recovery has followed the exhibition of large doses—half an ounce—of turpentine. In this dose, however, it sometimes produces alarming symptoms, and it is perhaps better to exhibit it in smaller quantities tentatively. An emetic may be serviceable, especially in children, if the tubes are much loaded. Children suffering from severe attacks of bronchitis should not be allowed to sleep long, for fear of dangerous accumulation in the tubes, and care should be taken that the secretions do not collect about the back of the mouth.

Patients should not be kept on a low diet even at the beginning of an attack, and as the disease progresses the quantity of food allowed may be increased according to the appetite. In the treatment of gouty bronchitis, or bronchitis associated with a tendency to the formation of uric acid in the system, colchicum and the alkalis must be given, and the general measures used which are applicable to the constitutional condition. If bronchitis depend on a gouty state,

it will not yield to the ordinary treatment, but when its cause is recognised and the appropriate remedies are administered, the symptoms usually soon begin to improve.

In the cases of bronchitis which are connected with heart-disease, and especially with mitral regurgitation, digitalis is often of great value. By steadying the action of the heart it relieves the overloaded pulmonary veins, and thus directly diminishes the congestion of the mucous membrane, as mentioned in the paragraph relating to the pathology of the disease.

It is impossible in the scope of this article to refer specially to the treatment of bronchitic attacks arising from the various kinds of mechanical irritation. There is, however, one form of bronchitis which may be mentioned, viz., that connected with hay-fever, arising either from the inhalation of pollen, or caused by some peculiar atmospheric influence acting on a peculiar nervous system. It is very difficult of cure. In the writer's experience no remedies seem to have any particular influence over it, and it is usually only to be relieved by removing the patient from the exciting cause of the affection. In the treatment of bronchitis depending on constitutional syphilis, the appropriate measures for that affection must be resorted to.

2. **Chronic Inflammation—Chronic Bronchitis—Chronic Bronchial Catarrh.**

Definition.—A chronic inflammation or congestion, more or less extensive, of the bronchial tubes.

Ætiology. — Chronic bronchitis very frequently results from repeated attacks of the acute disease, but it may be chronic from the beginning. Emphysema of the lungs, dilated bronchi, and phthisis are causes of the complaint; as are also various forms of heart-disease, and some blood-affections, such as gout. The inhalation of irritating particles gives rise to chronic bronchitis; and it is also met with in connexion with chronic alcoholism. It is most common amongst the old.

Anatomical Characters. — The bronchial mucous membrane is discoloured, being of a dull-red tint, greyish, or brownish. The discoloration is for the most part partially, but sometimes evenly, diffused. There is swelling and increased firmness of the mucous membrane, and the submucous tissue in old-standing cases becomes infiltrated and indurated. The fibrous and muscular tissues are hypertrophied; the cartilages in the larger tubes are sometimes calcareous; and there is generally more or less emphysema of the lungs.

Symptoms.—The symptoms of chronic bronchitis vary greatly in different cases. They resemble in kind those of the acute affection. There is cough, expectoration, pain, soreness or uneasiness behind the sternum, with more or less dyspnœa. The constitutional symptoms may be very slight, scarcely any effect on the general health being apparent; or they may be very severe. Three forms of chronic bronchitis are recognised clinically:—1. That which includes the ordinary cases of the disease, varying much in severity; 2. that characterised by excessive secretion—*bronchorrhœa*; 3. that form which is called *dry catarrh*.

1. In the first form of chronic bronchitis the cough is at first slight, perhaps only occurring during the winter, being altogether absent in the summer. After a time the attacks become more frequent, and at last the patient is never free from the affection, which is aggravated at times. The cough in such cases is more or less severe, but usually most so in the morning. It is often paroxysmal, and sometimes very violent. The expectoration, in some cases being scanty, viscid, and difficult to discharge, is in others, especially old-standing cases, copious and easy. The sputa vary much both in appearance and quantity. They may be yellowish-white muco-purulent matter, or more decidedly purulent, of a greenish-yellow or bright or dark green colour; they are but little aërated, sometimes not at all, so that they sink in water; at times they are nummulated and quite opaque. In some cases the expectoration is fœtid, constituting the form of the disease denominated 'fœtid bronchitis,' the odour resulting either from sloughs of minute portions of the mucous membrane, or from chemical changes taking place in the sputa. Occasionally streaks of blood are met with. Microscopically the sputa are found to consist of epithelium, pus-cells, and granular matter, with at times blood-corpuscles.

The constitution does not suffer much in mild attacks, but when chronic bronchitis is permanent and general, the system at large sympathises more or less severely: the appetite fails, sleep is disturbed by the cough, emaciation sets in and sometimes becomes marked, but it does not proceed beyond a certain point, unlike that of phthisis, which is usually progressive. In all cases of chronic bronchitis there is great risk of an acute attack coming on, especially amongst the aged. These attacks are very dangerous, in consequence of the rapid extension of the disease throughout the lungs, and its asphyxiating character.

2. The second class of cases is characterised by excessive secretion from the bronchial tubes —*Bronchorrhœa*. This form is often met with in the old and feeble, and especially in cases of valvular disease of the heart. The cough is paroxysmal, and attended with the expectoration of a large quantity of thin watery glairy fluid, or of thick ropy gluey matter, like white of egg The quantity expectorated is sometimes very large. This form of bronchitis may cause death somewhat suddenly by apnœa. During the paroxysms of cough there is dyspnœa, but at other times it is absent, except when heart-disease exists. The constitution suffers little, and the flux seems sometimes to be beneficial in cases of obstructive cardiac disease.

3. The third variety, or *Catarrhe sec*, is characterised by very troublesome cough, oppression of breathing, tightness of the chest, and sometimes severe dyspnœa. Expectoration is either absent or very scanty, the sputa consisting of small masses of tough viscid semi-transparent mucus. There is usually no febrile disturbance. The disease is met with in gouty people, and is often associated with emphysema of the lungs. Pathologically it seems to consist in a congested condition of the bronchial tubes.

Physical Signs.—Inspection reveals nothing abnormal in the form or size of the chest, unless

emphysema of the lungs is present. The expansion in long-standing cases is usually deficient; the chest being raised more than in health. Expiration is often prolonged. Rhonchal fremitus may be felt more or less, depending on the state of the bronchial tubes. There is often increased resonance, from the presence of emphysema. The breath-sounds are more or less changed; they are harsh and loud, and the expiration is prolonged in cases that have existed for a considerable period. The rhonchi vary; they are dry, coarse, moist, or bubbling according to the condition and contents of the tubes. Vocal resonance varies; it may be bronchophonic, normal, or deficient.

Diagnosis.—There is usually but little difficulty in the diagnosis of chronic bronchitis. The affection is most likely to be confounded with phthisis, but the character and degree of the wasting, and the absence of increased temperature, of hæmoptysis, and of the physical signs of consolidation, will generally enable the practitioner to decide in favour of the less important disease. The main difficulty lies in the diagnosis of cases where the bronchi are dilated; this will be referred to hereafter.

Prognosis.—Although in itself not a dangerous malady, chronic bronchitis becomes so in consequence of the liability which exists to the occurrence of acute symptoms; when once established in middle or advanced age it is almost incurable. The complaint is further serious from its tendency to produce emphysema and dilatation of the bronchi. *Per se* it can scarcely ever be said to kill.

Treatment.—No case of chronic bronchitis can be successfully treated without due regard to the constitutional condition of the patient. In some cases it is impossible to cure the disease, and all efforts should be directed towards preventing its extension; alleviating the symptoms to which it gives rise; and warding off acute attacks. Attention must be especially paid to the state of the heart and kidneys; the duration of the affection; the age of the patient; the characters of the expectoration; the state of the lungs, as to the existence of emphysema or other morbid conditions; and the presence of gout or rheumatism. Speaking generally, chronic bronchitis must be treated by the use of a generous diet, with more or less stimulants; by the exhibition of expectorants and tonics; and by the avoidance of all depressing measures. The function of the liver must be looked to, and the administration of a few doses of blue pill with a saline aperient often gives great relief, and alters the character of the bronchial secretion. If gout, or a tendency to the formation of uric acid, is present, colchicum with alkalis and other remedies for gout, such as a course of Friedrichshall or Carlsbad waters will prove of great service. If cardiac disease exist, whether in the form of valvular incompetence, or of weak, flabby, or dilated heart, digitalis combined with iron frequently produces marked benefit.

In the treatment of ordinary cases of chronic bronchitis, not dependent on any organic disease or constitutional condition, the patient's general health has to be looked to. The affection has a tendency to lower the health and to diminish strength, and therefore the various tonics may often be given with great benefit. Of these the most useful are quinine, the preparations of iron, and those of zinc. Cod-liver oil is also very valuable in some cases where there is much wasting. The cases of bronchitis marked by excessive secretion are generally best treated by tonics; whilst those where the secretion is slight—cases of 'dry catarrh'—being often associated with a gouty condition of the system, are more amenable to the use of colchicum, the alkalis, iodide of potassium, and mineral waters.

In what may be called the symptomatic treatment of the affection, the various expectorants are useful—carbonate of ammonia, ipecacuanha, squill, cascarilla, senega, chloroform, &c., and these may often be beneficially combined with some form of tonic. In many cases of chronic bronchitis the expectorating power is diminished, and stimulating expectorants are of great service. Great caution must be exercised in the administration of opiates and other narcotics or sedatives. When, however, the mucous membrane is very irritable, and when there is but little secretion with a troublesome cough, these remedies are indicated. Opium is of great value, and chloral hydrate is also very useful, as well as, in some cases, henbane and hydrocyanic acid, or, whenever spasm is present, stramonium, lobelia, the ethers, and cannabis indica. Inhalations are sometimes very beneficial, as of the vapour of warm water, iodine, creasote, and other substances. The inhalation of creasote is especially valuable if the expectoration is fœtid.

Counter-irritation is one of the most important means we possess of relieving chronic bronchitis. The irritation should not be excessive, but should be long-continued. The application of iodine over a large surface of the chest, so as to keep up a constant slight inflammation of the skin, is perhaps the best that can be used; but other irritants may be tried, such as sinapisms, or the various stimulating liniments.

The general management of the patient is most important. A mild climate should, if possible, be chosen in the winter. The patient should live as far as possible in an atmosphere which is mild and dry. Although some cases are benefited by a moist and warm atmosphere, the majority of cases of chronic bronchitis do better in a drier one. The skin must be carefully looked to, its action should be well maintained and warm clothing always worn. A moderate amount of some alcoholic stimulant is generally desirable; and the food should be nutritious and of easy digestion. Relief will often be found from wearing a respirator.

3. Plastic Bronchitis.—This is a rare form of disease, and of its particular causes nothing is known. It is perhaps connected with some peculiar diathesis. Sir John Rose Cormack suggests that it may be a variety of diphtheria. It may occur in either sex, and at any period of life, but is most frequent in those who are of a strumous or phthisical constitution. It has been known, however, to attack persons of apparently healthy frame and in the enjoyment of robust health.

Anatomical Characters.—Plastic bronchitis is anatomically characterised by the formation of concretions in the bronchial tubes. These

concretions consist of fibrinous exudation from the mucous membrane; they form casts of the tubes, and are expectorated. These casts are either solid or hollow, and on examination are always found to consist of concentric laminæ. They are, for the most part, poured out into the finer bronchial tubes, sometimes, however, into the larger ones, but never into the trachea. The casts are of a whitish colour, but they are often stained with blood. Microscopically they consist of an amorphous or fibrillar material, with exudation-corpuscles, granular matter, and oil-globules.

Symptoms.—This disease is essentially chronic, but it has been met with as an acute affection in children. At the times when the casts of the tubes are expelled exacerbations occur, the patient being attacked with pain and a sense of constriction across the chest, dyspnœa, and an irritating cough. After a time, varying from some hours to a few days, the dyspnœa becomes very urgent, and the cough very severe; then, after a paroxysm of coughing, it is found that the patient has expectorated some solid material, either with or without blood, usually intermixed with ordinary bronchitic sputa. The dyspnœa and cough now subside, to recur after an interval of a few hours or longer. The disease may last for weeks, months, or even years, marked from time to time by severe accessions, and relieved by the expulsion of further concretions. The matter expelled is often in small masses, but at times casts of bronchial tubes with several ramifications are expectorated. The disease may recur at intervals for many years; the general health in such cases does not seem to suffer, the breathing during the intervals being unaffected. There is, in some instances, an absence of febrile symptoms during the attack, whilst in others the fever is more marked. With the general symptoms are combined the *physical signs*. These are somewhat peculiar. The bronchial tubes being obstructed, portions of lung are deprived of air; the breath-sounds are therefore faint or absent. There may be dulness more or less complete on percussion, from collapse of the lung-substance, or, as occurs in some cases, from localized pneumonia. Apnœa may be threatened if a large tube is blocked up.

Diagnosis.—The diagnosis of this affection turns on the peculiarity of the expectorated matters. Doubtless the disease may be mistaken for ordinary bronchitis or pneumonia, but when once the fibrinous casts of the tubes are observed in the sputa, the nature of the case becomes clear.

Prognosis, Duration, Terminations, and Mortality.—The prognosis, if the disease is uncomplicated, is favourable; but there is great liability to recurrence. The complaint may last for many years; and may terminate in complete recovery. A fatal result generally depends on the presence of some other organic disease, such as phthisis or pneumonia.

Treatment.—But little can be advanced as to the value of any special treatment for this affection. Iodide of potassium is said to have been employed with success. The chief object should be to maintain the general health by hygienic measures, and the exhibition of tonics, such as iron, quinine, and cod-liver oil, especially if there be any tubercular taint. During the exacerbations the administration of ammonia and the use of inhalants should be resorted to, and the general principles on which ordinary bronchitis is treated should be carried out.

4. Dilatation.—Bronchiectasis.—This is a rare disease, which arises as a secondary affection. It is often associated with serious pulmonary mischief, and is at times difficult of diagnosis. There are two forms of bronchiectasis, namely *general or uniform dilatation*; and *saccular or ampullary dilatation*.

1. The *general* or uniform bronchiectasis consists in a cylindrical dilatation of one or more of the tubes throughout a considerable portion of their extent. The tubes are evenly widened for the most part, and end abruptly.

2. The *saccular* form of bronchiectasis consists of a globular dilatation of a tube at one point, or at several points. The dilatations vary in size, being from half an inch to an inch or more in diameter. On the tracheal side they usually communicate with a slightly enlarged bronchial tube, whilst on the peripheral side the continuity of the tube is almost or entirely lost from narrowing or actual obliteration. Sometimes the cavities communicate with one another.

The two forms of bronchiectasis often coexist.

The walls of the dilatations undergo changes in the course of the disease. The mucous membrane becomes granular, swollen, and congested: while at a later stage it presents a velvety or villous appearance, and in some cases there is even ulceration with superficial necrosis. The muscular and elastic coats become atrophied, and coincidently with this dilatation increases. At times the wasting of these coats is partial; some portions of the walls retaining their natural volume, and forming bands or ridges elevated above the surrounding membrane. The dilated tubes occasionally present an appearance of hypertrophy; the walls are thickened, but the thickening depends on changes which have taken place in the mucous membrane. The cartilages resist the destructive metamorphoses longer than the other structures, but they sometimes partake of them. The contents of the tubes may be either muco-pus, or pus; and casts of the minute bronchi are met with. At times the contents are very fœtid. Crystals of margarin are occasionally found, and sometimes fragments of pulmonary tissue. It is said that the contents may become calcareous.

Dilatation of the bronchi may be unattended with any change in the surrounding lung-tissue, but, generally speaking, condensation of the latter takes place, either as the result of pressure or of chronic pneumonia. In some instances the tissue forms an abscess, in the centre of which the walls of the bronchus are found, whilst in others the walls of the bronchi and the surrounding tissue are destroyed by gangrenous inflammation. It is generally not difficult to distinguish between a phthisical cavity and a dilated bronchus. The latter is not characterised by the broken irregular surface which usually exists in the former; its shape is generally more regular; and it is usually continuous with bronchial tubes. The surrounding lung-tissue has no tubercular infiltration.

The *mechanism* of bronchiectasis has occupied much attention. It is probable that the elastic and muscular fibres lose their elasticity and contractility as the result of chronic inflammation, and thus yield to the distending influence of coughing. When once a dilatation is produced, accumulation of the secretions takes place, which tends further to increase the dilatation.

Symptoms.—The symptoms of bronchiectasis are those of chronic bronchitis aggravated in some important respects. The cough is frequent and paroxysmal. The expectoration is very abundant, very purulent, and, when the disease has lasted some time, very fœtid. The breath also becomes fœtid. Hæmoptysis is occasionally met with, even to a considerable extent. There is more wasting than in ordinary bronchitis, and the blood is more imperfectly aërated. Night-sweats are not uncommon. In fact, the general symptoms approach those of phthisis. The digestive functions are usually not much impaired.

Physical Signs.—The movement of expansion is diminished in bronchiectasis, while that of expiration is prolonged. Over the affected portions of the lung there may be slight retraction. Vocal fremitus is increased, and rhonchal fremitus is sometimes well marked. The percussion-note is altered. If a dilated tube is surrounded by condensed lung-tissue, or is full of secretion, there is dulness on percussion; but if it is situated near the surface and empty, some degree of tubular resonance may exist. Cracked-pot sound may be at times elicited. The respiratory sounds are harsh, or loudly bronchial with a more or less blowing character, and they may be distinctly cavernous. Vocal resonance is often greatly increased. The pulse becomes rapid in the later stages. The temperature rarely if ever reaches the height that it does in phthisis with cavities, and the daily oscillations are not so marked.

Diagnosis.—The main difficulty as regards diagnosis is in the differentiation of certain cases of phthisis with cavities from bronchiectasis with large globular dilatations. The points to be relied on are that in the latter disease the morbid physical signs are usually met with at the middle and lower parts of the lungs, whilst in ordinary phthisis they are found at the apex; that the temperature differs in the two affections as mentioned above; that emaciation and night-sweats are not so marked in bronchiectasis; and that, if cases are watched, there is usually observed a progressive advance of symptoms in phthisis, whilst in bronchiectasis the symptoms may remain stationary. In phthisis signs of consolidation precede those of cavities, whilst they follow them in bronchiectasis. Bronchial dilatations and tuberculous cavities have been found in the same lung. The fœtor of the breath and sputa in bronchiectasis may cause a suspicion that gangrene of the lung is present; but the general symptoms will usually enable the practitioner to differentiate between the two affections.

Prognosis.—Bronchial dilatation is probably never cured. It may last for years.

Treatment.—The treatment of bronchiectasis must be that of chronic bronchitis with the use of such measures as are applicable to wasting diseases in general. The fœtor of the breath is best relieved by the inhalation of creasote.

5. **Narrowing or Obstruction.**—Narrowing or obstruction of the bronchial tubes is by no means uncommon, and may depend on intrinsic or extrinsic causes. Complete obliteration of a tube is sometimes found in connection with bronchiectasis, immediately beyond a globular dilatation.

Ætiology.—The *intrinsic* causes of obstruction are a thickening of the mucous membrane resulting from bronchitis; the retention of viscid secretions; the exudation of plastic material into the interior of the tubes; and the deposition therein of tubercle or cancer.

Amongst the principal *extrinsic* causes are: the pressure of adjacent tuberculous or cancerous deposits; the contraction of plastic matter exuded into the tissues surrounding the tubes; solid formations in the pleura; enlarged bronchial glands; and aneurismal and other thoracic tumours.

Obstruction is most frequently met with in the smaller tubes, but the pressure of thoracic tumours not unfrequently causes obstruction, or even obliteration of a main bronchus, which occasionally—as in the case of aneurisms—becomes perforated.

Symptoms.—If a large bronchial tube becomes suddenly and greatly obstructed, dyspnœa of an urgent character sets in, and death from apnœa may speedily result, unless the obstruction be removed. When the obstruction is on a smaller scale, being confined to the smaller tubes, or when a large tube suffers only from slow, gradually increasing obstruction, the symptoms are by no means urgent for a time, and slight dyspnœa, sometimes accompanied by stridor, is the most marked feature.

Physical Signs.—Complete obstruction of a bronchial tube invariably leads to collapse of the portions of the lung to which the tube is distributed, and thus an entire lung may collapse if its main bronchus be obliterated. Where partial collapse is produced, emphysema of the neighbouring lung-tissue commonly follows, and if one lung become collapsed, the opposite lung becomes enlarged and emphysematous. The existence of collapsed lung gives rise to dulness on percussion over the affected part, unless this be situated away from the chest-walls, or masked by the presence of emphysema. Further, obstruction of the bronchi causes a weakness or deficiency of the respiratory sounds, with a prolonged expiratory murmur, attended at times with sonorous and sibilant rhonchi. Over the collapsed portion of the lung, or over portions of the lung supplied by a tube which has become completely obstructed, the breath-sounds are absent. Deficiency or absence of vocal vibration is another physical sign of obstructed bronchial tubes.

Treatment.—The treatment of obstruction of the bronchi must depend on the nature of its cause. The chief interest of the affection arises from the means of diagnosis of thoracic tumours which it may afford.

6. **Cancer.**—Cancer of the bronchial tubes occurring independently of cancer in the lungs, or mediastina, is probably never seen; but can-

cerous matter has been found in the tubes: (1) in cases where the lungs have been infiltrated with a similar deposit; (2) where a cancerous tumour connected with the root of a lung has perforated a tube; and (3) in some cases of cancerous disease of the lung, a tumour of a similar nature being found connected with the mucous membrane of a tube. (4) Cancerous matter has also been found *in transitu* in a tube, having been detached from a cancerous mass.

A. T. H. Waters.

BRONCHIAL GLANDS, Diseases of.—Synon.: Fr. *Adénopathie Trachéo-bronchique*; Ger. *Krankheiten der Bronchialdrüsen.*

Definition.—Disease of those lymphatic glands which are situated at the bifurcation of the trachea, between the right and left bronchus, or upon these tubes and their primary divisions.

General Description.—A short reference to the anatomical relation of these glands in connexion with their pathological and clinical history will be useful. Taking the bifurcation of the trachea as a starting point, we find in the space between the right and left bronchus a group of glands. They are from ten to fifteen in number, and they vary in size from that of a small pea to that of an almond. The glands towards the right bronchus are larger than those towards the left. Glands are also situated upon the tubes; they are few in number and small. The vascular supply of the glands, which is free, is derived from the bronchial arteries, and the blood is returned to the bronchial veins. Afferent lymphatics reach the glands from the lungs, from the pleura, from the neck, and other neighbouring parts. Besides these groups of comparatively large glands, numerous minute lymphatic glands are found in connection with the primary division of the bronchi, chiefly at the back of these tubes at their bifurcations and at those of the pulmonary artery. The central group of glands is in relation in front with the pericardium, the arch of the aorta, and the pulmonary artery; behind with the pulmonary plexus of nerves, the œsophagus, the aorta, the vena azygos, &c. The ganglia on the upper, anterior, and posterior surfaces of the right bronchus are four or five in number and smaller than those of the central group. Their situation brings them into relation with the arch of the aorta, the innominate and subclavian arteries, with the brachio-cephalic vein, and with the vena azygos, the pneumogastric nerve, and its recurrent branch. The ganglia on the left bronchus are still smaller than those of the right side. Their position gives them relations with the arch of the aorta, the origin of the left carotid and subclavian arteries, the left branch of the pulmonary arteries, with the large veins, with the left pneumogastric nerve, and especially with its recurrent branch. Lastly it should be stated, as a guide in clinical examination, that the bifurcation of the trachea takes place in front of the body of the fifth dorsal vertebra, or between the fourth and fifth, and behind the lower end of the first bone of the sternum. The glands, except when diseased, are proportionately larger in children than in adult or aged persons. Knowing that these glands in common with other lymphatic glands, are liable to such diseases as enlargement, abscess, morbid deposits, growths, and other textural changes, and bearing in mind, as just mentioned, their relations to surrounding organs, we can readily see that the study of their diseased conditions is important. Not only is their study important in reference to the diseased glands themselves, but by reason of their modifying or masking the symptoms of disease in other organs, as results of the pressure which when enlarged they cause on nerves, air-passages, blood-vessels, &c. Throughout English and foreign medical literature numerous cases will be found described, in which there existed, more or less conspicuously, striking disease of the bronchial glands, little notice, however, being taken of less striking, though far more numerous, examples of disease. It is only within a comparatively recent time that the subject has received special attention and been discussed as a disease *per se*.

MM. Rilliet and Barthez, in their well-known *Traité des Maladies des Enfants*, have described the disease in infants, and Dr. West, in his work on *The Diseases of Infancy and Childhood*, has fully and clearly described—under the head of Bronchial Phthisis—the tubercular diseases of these glands in young subjects. It is, however, to M. Noel Gueneau de Mussy, following up and widely extending the investigation of his predecessors, that we are especially indebted for our knowledge of the effects of these lesions, and to his pupil M. Baréty, who has published an exhaustive memoir upon these, under the title *L'Adénopathie Trachéo-Bronchique*. The subject has attracted the present writer's notice since (or even before) the year 1853, and the notes of nearly sixty cases which have fallen under his observation will form the bases of some of the conclusions to be subsequently stated in this article.

Morbid Anatomy and Pathology. — The bronchial glands participate in the diseases which affect lymphatic glands generally, and which will be found described in another article. (*See* Lymphatic System, Diseases of.) Here it will suffice to enumerate the principal morbid changes to which they are liable, referring briefly to any special circumstances in connection with these particular glands.

a. The bronchial glands are liable to *congestion* with enlargement as are glands in other situations. *Hypertrophy* will be the result of this last condition becoming chronic. The glands in this situation become after childhood almost invariably studded with black deposits, the quantity of which may be so considerable as to constitute *melanoma*.

b. These glands are liable to *acute* and *chronic inflammation*. Acute inflammation in this situation, terminating in *abscess*, is rare, but several cases of the kind have been recorded. Chronic inflammation of the glands is by no means uncommon. It may lead to permanent enlargement, to contraction and induration of the glandular textures, with the presence of calcareous particles, or to abscess. The contents of the abscess may be more or less completely absorbed, leaving a partially filled *sac* or *cyst*, containing thick pus or cheesy matter. But these glands, when inflamed and enlarged, may form adhesions with surrounding parts, and

the contents of an abscess, if it exist, may be discharged, by an *ulcerative* process, into the substance of a lung, into the mediastinum, into the trachea, or œsophagus, or even into a blood-vessel. *General emphysema* has occurred in such cases; whilst the emptied sac has assumed in some instances the character of a *cavity* connected with the lungs. When the matter is discharged into the air-passages, *purulent expectoration* is the result. Two or three examples of such cases were noticed in the writer's observation, and the possibility of their being mistaken for the discharge from a cavity in the lungs, or an empyema, was remarked upon at the time. The abscess may discharge into the mediastinum. A remarkable instance of the kind is recorded in the case of the late much lamented Dr. Fuller. A chronic abscess of the bronchial glands had opened into the posterior mediastinum. This led to pyæmia, the formation of abscesses in the brain, and to the loss of a valuable life.

c. These glands are liable to suffer especially from *tuberculous* or *scrofulous disease*, from various forms of *malignant disease*, and in *secondary* or *tertiary syphilis*. Of the latter form of disease, some striking examples have fallen under the notice of the writer, in which symptoms closely resembling phthisis existed, but which yielded to treatment directed to the specific disease.

Ætiology.—The causes which give rise to disease of the lymphatic glands being discussed in another article, reference will here be made only to the special circumstances which influence the particular glands, and thus it will be sufficient merely to allude, amongst *predisposing causes*, to hereditary predisposition, to general impairment of health, and the like. With regard to the influence of age and sex, reference has already been made to the works of Rilliet and Barthez, of Dr. West, and of other authors who described the frequency of the disease in childhood. The writer's observations made on young persons and adults show that of 58 cases (of whom 21 were males and 36 females—in one case the sex was not recorded) 2 were under 10 years of age, 9 were between 10 and 20 years of age, 18 were between 20 and 30, and 26 were over 30 years of age. In three cases the age was not stated. If these observations justify any inference, it is that females are more liable to disease of the bronchial glands than males, and that the disease occurs with increasing frequency after the age of puberty. Amongst the *exciting causes* of disease in these glands we may leave to be considered elsewhere those general conditions which give rise to disease in these and other glands, such as scrofula, tubercle, malignant disease, &c., and pass on to the consideration of the more immediately *local* exciting causes. *Cold* leads frequently to congestion and enlargement of the bronchial glands. But it is to local irritation or inflammatory disease in organs or tissues with which these glands have a connection that the source of disease may be frequently traced. As we find the submaxillary or cervical lymphatic glands enlarged from irritation or disease in the mouth or throat, or the axillary glands or inguinal glands enlarged from irritation or inflammation about the hands and feet, so we may find the bronchial glands enlarged temporarily or permanently from inflammatory disease in parts the lymphatics of which pass to these glands. These glands have been observed to be enlarged in the course of or after certain acute specific diseases, such as scarlet fever, measles, and typhoid fever. In whooping cough this enlargement has been so frequently observed by M. Guéneau de Mussy, that he believes this disease to be an exanthem of the bronchial mucous membrane, and that this local condition leads to enlargement of the glands, which, again, by pressure on the pneumogastric and recurrent nerves, gives rise to some of the special phenomena of the disease, such as crowing cough, and even to the vomiting so frequently observed in this disease. It is right to remark here that the late Dr. Hugh Ley speaks interrogatively, in his work on Laryngismus stridulus, of enlarged bronchial glands being capable of producing a cough like that of pertussis, and he further alludes to some cases of whooping cough in which the glands by the side of the trachea were enlarged. He asks, 'May it not be that an enlargement of these glands from a specific animal poison, similar to that of the parotid gland in mumps, is after all the cause of whooping cough?' (Note, p. 440.) The same author gives several beautiful illustrations of diseased bronchial glands pressing upon the pneumogastric and other nerves. The black deposit so often found in the glands is the result of the absorption of carbonaceous or pigmentary matter from the lungs.

Symptoms.—The symptoms which have been recorded by the writer as more or less characteristic of the presence of enlargement of the bronchial glands are as follows:—

1. *Cough*, which is noted as being a prominent symptom in 39 cases. In 21 of these cases it was stated to have been the most troublesome of the symptoms present. In 6 cases it was described as harsh and laryngeal; in 4 cases spasmodic, resembling whooping cough. In other cases, 5 in number, it was characterised as short and hacking, constant, incessant, and in one case the sound resembled that made by the cough of a sheep.

2. *Pain* is, in regard to the frequency of its occurrence, the next symptom recorded. It was mentioned as being present in 22 cases. The seat of pain was almost constantly referred to the situation of the fourth and fifth dorsal vertebræ at one or both sides of the spinal column. The pain was mentioned in a few cases as existing only in front, beneath and at one or both sides of the upper end of the sternum and below the clavicles. The feeling was described in some cases (5) as of distressing tightness, and in one case as a 'spasm.' Tenderness on pressure over the seat of pain was very frequently observed. The persistence of the pain was very varied.

3. *Difficulty of breathing* was a noticeable symptom in several cases. In 13 it was recorded as being specially so; in 4 it had all the characters of spasmodic asthma, occurring at intervals and especially during the night.

4. *Difficulty of swallowing* was noticed in 10 cases; in one of these the difficulty was remarked especially in swallowing liquids.

5. *Hæmoptysis* was present in 10 cases. The amount of blood varied in these cases from

marked streaks to copious expectoration, lasting two or three days. No case was recorded as presenting this symptom except on tolerably clear proof that it depended on bronchial gland enlargement, and on no other cause.

6. *Congestion* and puffiness of the face have been mentioned as present in 3 cases.

7. *Expectoration of mucus*, such as results from bronchial catarrh, was frequently present. Expectoration of pus was present in 3 cases. In each it resembled the contents of an ordinary glandular abscess mixed with air. In one of these the discharge was intermittent. The frequent occurrence of cough without any expectoration was remarked in many cases. Calcareous particles are mentioned also as having been expectorated.

8. *Loss of voice* (4 cases) and hoarseness (2 cases) are recorded as striking symptoms.

9. *Vomiting* is mentioned as having been present twice.

10. Lastly, the *position* assumed with least discomfort by the patient when in bed was noticed in 41 cases. Of these 23 rested on that side on which the glands were mentioned as being chiefly if not wholly affected. In 15 cases an opposite condition was noticed. In 2 cases lying on the back was the most comfortable position. One patient, unable to lie down, sat when in bed, and stooped forward. One patient, a little boy, could only rest on his face and knees. This case was further remarkable in reference to the clearness with which the disease was recognised and the successful result of subsequent treatment.

It might be mentioned here incidentally that the glands of the right side were noticed as being chiefly affected in 28 cases, and of the left in 22 cases—in 4 both sides seemed equally affected, and in 4 no record was made. The general or constitutional symptoms connected with the malady under notice need not be discussed here. They are in nowise peculiar, and will be found discussed elsewhere. The symptoms described above have special reference to the bronchial glands. The cough and its peculiar characteristics are, no doubt, in a great measure dependent on pressure or on irritation communicated to the pneumogastric nerves and their branches. So likewise pain and difficulty of breathing, in a great degree, through direct pressure on the air-passages, may also cause or aggravate these symptoms. Aphonia especially seems to have relation to the condition of the recurrent nerves. In one of the cases which the writer saw with Mr. Lennox Browne, paralysis of the left chorda vocalis existed. The diagnosis of glandular disease was clear, a conclusion confirmed by the results of treatment. Vomiting is mentioned in two cases. M. de Mussy says that this is a more frequent result when the left pneumogastric nerve is pressed upon. He sees a connexion between the troublesome vomiting which occurs in some cases of tubercular disease of the lungs with like pressure upon nerves. The puffiness of the face and eyes noticed in these cases is due to the pressure on the venous trunks, a condition which also accounts not only for hæmoptysis, but for bleeding from the nose, occasionally present. Copious and sometimes persistent hæmoptysis has been traced to the perforation of a vessel (ulceration in connexion with disease of the glands).

The Physical Signs noticed in the 58 cases referred to were: 1. *Dulness.*—It was present in 47 cases. It was found between the margin of the scapula and the spinal column at one or both sides, on a level with the fourth and fifth dorsal vertebræ. It varied in degree, and was more readily manifested when the muscles of the back were made tense by folding the arms across the chest, and was often strikingly distinct when one side was contrasted with the other. Dulness was present in front in 8 cases (whether coincidentally with dulness at the back or not is not clearly stated), beneath the top of the sternum and at each side below the sterno-clavicular junction. The dulness here was best elicited by the patient holding the head backwards whilst percussion was being made.

2. *Flattening* of the affected side in front was mentioned in 3 cases. *Diminished mobility* of the affected side, independent of flattening, was recorded in 4 cases. Prominence in front was not recorded in any case, though, no doubt, it occurs sometimes.

3. *The respiratory sounds* were variously modified. *Marked tubular breathing* was recorded as being present over the seat of disease in 14 cases. In 10 the expiratory murmur was described as being *very loud*, various modifications of the inspiratory murmur being found at the same time. *Feebleness* of the respiratory murmur as a whole was noticed in 14 cases. In some this deficiency extended over the whole lung; in others it existed over the upper or lower portion of a lung, behind or in front. The observations made on the voice by the writer were few, but M. de Mussy and M. Lereboullet speak of a peculiar and increased reverberation of both the voice and the cough. Dr. Eustace Smith has described in the cases of children a venous hum, heard at the root of the neck when the head is thrown back, caused by the pressure of the enlarged glands on the venous trunks.

Diagnosis.—In the present article those cases are not kept in view in which the bronchial glands becoming the seat of constitutional disease in association with other glands in the neighbourhood, constitute large and manifest tumours—such will be found described under another head (*see* Intrathoracic Tumours). Nor has it been intended to give prominent consideration to the state of the glands when they enlarge in acute disease—such as eruptive fevers; nor in those diseases—such as typhoid—where the glands play a secondary part. The writer has been anxious to describe and to assist in recognising the presence of a condition in which the disease of the bronchial glands constitutes to some extent a disease *per se*, or gives rise to complications which it is important to discriminate. He believes the symptoms and signs above described will suffice for the purpose, always remembering that in the present and in all similar instances it is necessary to take means for excluding in our investigations diseases which may produce like phenomena. Thus we may find cough, pain, tenderness on pressure and aphonia in a case of hysteria without any

evident structural disease. On the other hand a small tumour, say, a small aneurism, may produce all the signs of pressure which are above given as the signs of bronchial gland-enlargement. It is the duty of the physician to recognise these differences and distinctions, to trace them to their origin, and thus establish as far as may be the nature of the disease under investigation.

PROGNOSIS will in this, as in like instances, so entirely depend on the nature of the disease, on its amount and its condition, on its relation to and effects on surrounding organs and textures, that each case must be regarded independently. It would be impossible to discuss them fully here—all that can be said is that the simple enlargements generally yield to treatment and within a reasonable period.

TREATMENT.—In several cases of morbid gland-enlargement, treatment has proved very effective. These cases would seem to be those of simple chronic enlargement. Many such cases have yielded to the use of iodide of iron in the form of pills or syrup, and to the external application of a solution of iodine, composed of equal parts of the tincture and the liniment of iodine, between the shoulders. The same treatment has likewise proved very effective in cases in which a syphilitic origin for the disease could be traced. Symptoms such as cough, difficulty of breathing, pain as well as dyspnœa, loss of flesh, strength, &c., will all require more or less suitable treatment. The cough and difficulty of breathing may in some cases be relieved by simple expectorants or antispasmodics. A useful application when pain is a prominent symptom, is an embrocation composed of equal parts of chloroform, belladonna liniment, laudanum, and spirits of camphor. A couple of drachms of this composition sprinkled on the surface of piline and applied on the painful part for a few minutes, often affords relief. Hypodermic injection of morphia may be required when pain is very severe. Under all circumstances it is necessary to improve the general health by wholesome diet, pure air, and the other conditions which will promote good digestion and elimination from the excreting organs.

R. QUAIN, M.D.

BRONCHOCELE (*βρόγχος*, the throat, and *κήλη*, a tumour). A synonym for goitre. *See* GOITRE.

BRONCHOPHONY (*βρόγχος*, the throat, and *φωνή*, the voice). The resonance of the voice, as normally heard on auscultation over those parts of the chest which correspond with the main bronchi, and, in certain mordid conditions, beyond these situations. *See* PHYSICAL EXAMINATION.

BRONCHO-PNEUMONIA. A synonym for catarrhal pneumonia. *See* PNEUMONIA.

BRONZED SKIN. A peculiar discolouration of the skin frequently associated with Addison's disease. *See* ADDISON'S DISEASE.

BROW-AGUE. A synonym for frontal neuralgia, or tic-douloureux. *See* NEURALGIA; and TIC-DOULOUREUX.

BRUIT. (*Bruit*, Fr., a noise.) A word used to designate various abnormal sounds heard on auscultation, in connexion with the heart or vascular system. *See* PHYSICAL EXAMINATION.

BUBO (*βουβών*, the groin).—SYNON.: *Apostema inguinis*; *dragoncelus*; Fr. *Bubon*; Ger. *Leistenbeule.*

DEFINITION.—An affection mentioned in the most ancient medical writings, but not properly distinguished in its several varieties until the present century. Inflammation of any lymphatic gland, set up by irritation of the surface connected with the afferent ducts of that gland, has been called *bubo*; but the term is almost exclusively confined to swelling of the glands of the groin consequent on venereal irritation of the genitals, and will be so employed here.

VARIETIES.—Buboes are divided into:—1. *Simple bubo*, known also as *sympathetic bubo*, due to inflammation of a gland through ordinary irritation from an inflamed surface. 2. *Specific bubo.* (*a*) The *chancrous* or *virulent bubo*, or abscess inoculated with the pus of a chancre. (*b*) The *syphilitic bubo*, or indolent enlargement of the lymphatic glands accompanying the development of the initial sore of syphilis.

The glands first affected in the sympathetic and in both kinds of specific bubo are always those in most direct communication with the sore. Further, according to Ricord, when chancrous matter has reached a gland through the absorbent ducts, it never passes beyond that gland into another more remote in the series. On the other hand, the effect of syphilitic absorption is general, and affects those remote from, as completely as it does the glands nearest to, the inlet of the poison.

Buboes occur most frequently on the side of the body occupied by the source of irritation, still not rarely on both sides, and sometimes only on the side opposite to the position of the exciting sore. The crossing of the irritant is due to anastomosis or interlacing of the lymphatics at the mesial line. When bubo forms in both groins, there is usually a sore at the mesial line or on each side. Bubo, including simple and virulent, occurs in about thirty per cent. of chancres; how often with urethritis and other lesser venereal affections is not known.

1. Simple Bubo—Adenitis (*ἀδήν*, a gland).

ÆTIOLOGY. — This variety may be caused by:—(*a*) Mechanical irritation of the surface; such as erosions or fissures irritated by dirt or by caustic applications. (*b*) Urethritis, balano-posthitis, or a chancre when acting as a simple local irritant. Simple bubo is also often excited by herpes, erysipelas, boils, or other non-venereal irritants of the genitals. (*c*) Lastly, though nearly all buboes can be traced to a lesion of the part where their absorbents arise, there are a very few with which no lesion is present. Such are caused by excessive sexual intercourse or excitement; they are met with generally among young lads and girls. This form has received the names of *idiopathic bubo*, *bubon d'emblée.*

SYMPTOMS.—There are two forms of simple bubo:—1. Slight swelling and tenderness of one or several glands, ending in a few days by resolution. This occurs most frequently in urethritis, balano-posthitis, or simple chafings.

In genuine chancre the next and more serious form is most frequent. 2. Swelling, commonly of one, seldom of several glands; brawny thickening of the surrounding tissues; redness of the integuments; great tenderness and pain, especially when walking. In a few days this condition terminates either by abscess, by gradual subsidence to the normal state, or by chronic induration of one or more glands. When the bubo suppurates, the matter, instead of pointing at once, may burrow in various directions among the layers of cellular tissue before it breaks through the skin. The pus of this form of bubo is always the ordinary pus of inflammation.

Such cases may terminate by gradual conversion into chronic fistulæ, or the glands may degenerate in scrofulous persons by enlargement and suppuration, or there may be successive formation of abscesses around the glands with undermining of the skin. This is most frequently seen in persons who have previously had constitutional syphilis, erysipelas, and other septic inflammations.

Prognosis.—This form of bubo is seldom dangerous, but serious where it terminates in burrowing; it is then often very tedious and exhausting to the patient.

2. **Specific Buboes.**—(*a*) *Virulent bubo.* This is in reality an enormous chancre, identical in all but size with the sore whence it was inoculated. This form is never met with in gonorrhœa or in syphilis, being a consequence of the local sore only. It may be generated in two ways. 1. By touching the surface of a simple open bubo with chancrous pus. 2. By absorption of chancrous pus along the lymphatic ducts leading from the chancre to the gland most directly connected with the sore. Two pathological facts prove the reality of this mode of origin. First, occasionally small circumscribed abscesses form in the course of the lymphatic ducts before they reach the gland. These little abscesses when opened present the peculiar characters of the chancre. Secondly, until the necrosing action has laid open the interior of the lymphatic gland nearest the original chancre, the abscess about the gland retains its ordinary phlegmonous character.

The conditions which assist or hinder the conveyance of chancrous pus along the lymphatic vessels are wholly unknown.

The proportional frequency of virulent bubo to the number of chancres is not known. It is far less frequent than simple bubo. It is said that women suffer more rarely than men in proportion.

When not accidentally inoculated, virulent buboes are almost wholly confined to the groin, and originate in the gland which lies commonly in the centre of the group over the great blood-vessels. Occasionally with chancre on the finger, the epitrochlear or axillary glands develop into virulent bubo. Hübbenet of Kiew experimentally inoculated a soft chancre on the cheek, which was followed by virulent bubo of the gland in front of the tragus of the ear. This bubo is generally unilateral; rarely are both sides of the body affected; in such cases the chancre is usually at the mesial line, or there are two chancres. Still more rarely the bubo forms at the side of the body opposite to that of the chancre. The time for appearance is generally in the first or second week of the existence of the chancre; but it may occur at any time while the chancre is spreading.

Symptoms.—At first the symptoms of specific bubo are those of acute abscess forming rapidly round a single gland. Thus far they differ nowise from those of simple bubo. When the contagious pus reaches the abscess accidentally from without, or from within the gland by ulceration or incision of its capsule, the simple suppurating cavity becomes a spreading ulcer, which rapidly makes itself widely open by destruction of the integuments. The skin, thin as tissue paper, gives way at several points, and lets out a large amount of matter, which is thin, yellowish-grey or yellowish-red, with shreds of a chocolate colour floating in it. When perforated, the skin breaks rapidly away until the cavity is widely exposed.

The further progress varies. In the least severe variety the edges of the skin ulcerate irregularly for a short distance, then thicken and begin to granulate; the floor of the ulcer loses its unevenness and rises up to the level of the skin, and cicatrisation follows. But commonly a much greater destruction of tissue is effected. The skin is eaten away into wide gaps; the floor burrows under the skin in long channels, or dives deeply among the great vessels. In other cases serpiginous ulceration produces a large shallow sore. The contagious condition of these buboes often continues for weeks or months, so that consecutive inoculation of the skin is not infrequent. The characters of the fully formed virulent bubo are those of the chancre. The surface is greyish-brown, dug-out, 'worm-eaten;' the borders at some parts are thickened, everted, and pared away, at others sharply eroded or undermined and curled in. The matter is thin, shreddy, plentiful, reddish in colour, and inoculable. Again like the chancre, the virulent bubo passes through periods of *extension*, *stagnation*, and *repair*. The last stage is often long postponed by *phagedæna*, a characteristic of no other bubo, but another mark of kinship to the chancre. Phagedæna very rarely attacks a bubo if it attacks the original sore. The virulent as well as the simple bubo is liable to erysipelas and inflammatory sloughing.

The *duration* of virulent bubo for the reason stated is wholly indefinite—in a few cases ending in a week, in many lasting for months or even several years.

Phagedæna.—The form of the sloughing in phagedæna is most commonly serpiginous. In this way the bubo may wander over the abdominal wall, the hip, thigh, and perineum, healing here and spreading there, or digging deeply among the muscles. Generally proceeding at this imperceptible speed, the phagedenic action may suddenly destroy the tissues with great rapidity for a time, and then pause altogether till another rapid extension is made. In this manner years may pass before healing is complete.

Diagnosis.—The virulent bubo has in its early stage no distinguishing mark from the simple acute bubo. After it has become inoculated with

the contagious matter it is distinguished from every other affection by the characters already described. The earliest signs of virulence are two; the matter which escapes when the bubo is lanced is thin and shreddy, and the edges of the cut become in a day or two eroded and partly covered by adherent sloughs. Subsequently other characters develope and remove all doubt. Nevertheless, in some cases the signs of virulence are so feebly marked throughout that the diagnosis remains uncertain. This difficulty may be increased by the primary sore having healed before the suppuration of the bubo, or by its being hidden in some unusual position (urethra, anus).

Prognosis.—This is not always grave. Virulent buboes often reach cicatrisation in a few weeks, and meanwhile cause no serious inconvenience. On the other hand, they are prone to inflammation, or to phagedæna, and thus may permanently cripple or even destroy life.

(*b*) *Syphilitic Bubo* (*indolent multiple bubo, pléiade ganglionnaire*).—This enlargement of the group of lymphatic glands in nearest connection with the initial sore is the constant, or at least almost constant, symptom of early syphilitic infection. In this it differs much from the bubo of chancre or gonorrhœa, in which affections the bubo is more often wanting than present. Four conditions have been noted to exist in patients in whom the enlargement of the glands could not be detected, namely, 1. Phagedæna of the sore. 2. Obesity; in such persons the lymphatic system as a rule is small. 3. Second infection; *i.e.* a primary sore on a patient who has had constitutional disease before. 4. Scantiness of the induration of the primary sore, the sore itself being ill-developed. But these exceptions are most rare. Fournier gives five instances only in 265 cases of hard sore, accompanied by well-marked general syphilis; or 2 per cent. In 176 similar cases noted by the writer, three had no apparent inguinal enlargement. One of the patients was a very fat man, and in another the initial sore was only slightly hardened.

The seat of this bubo is, in the great majority of cases, the groin, whither, besides the lymphatic ducts of the external genitals, those of the anus, perinæum, buttocks, and lower part of the abdomen are directed. But the glands of other regions, epitrochlear, axillary, sub-maxillary, buccal, cervical, and nuchal are all occasionally found primarily enlarged when the syphilitic poison enters the body through the regions whence their absorbent ducts are derived.

In the groin the bubo is generally *double*, that is, the glands are enlarged in both groins, those on the side of the sore being most affected. On the other hand, only those on the same side as the sore, in a few cases, enlarge, and in rare examples only those of the side opposite to that of the sore. This enlargement affects the group widely, for when the deeply-placed glands can be examined they are found to be similarly enlarged along the iliac vessels and lumbar vertebræ. Indeed, in some persons all the lymphatic glands of the body are temporarily increased in size.

The enlargement of the glands is first perceived about eleven days after the induration of the sore, though probably the affection commences at the end of the incubation of the poison. In extremely rare instances enlargement is delayed until the third or fourth week after the induration of the sore.

Symptoms.—The distinguishing marks of this bubo are swelling, wholly devoid of inflammatory character, and rarely surpassing an almond or a hazel nut in size; gristly hardness; ready isolation and mobility; insensibility to pressure; natural hue and condition of the overlying skin; and absence of fulness of the cellular tissue.

The gland in most direct communication with the sore is most enlarged; in rare exceptions only a single gland is enlarged. Copious enlargement of the glands does not always attend copious induration of the sore, nor is scanty induration of the sore always accompanied by small swelling of the glands, though commonly this is the case. So also, though absence of tenderness is the rule, the glands may be slightly painful if pressed. Again, though the glands remain distinct in most cases, they have been known to coalesce into a single mass, which becomes fixed to the fascia. In many patients the dorsal lymphatic vessel of the penis becomes indurated sufficiently to be easily distinguished under the skin.

This bubo reaches full development in one or two weeks, and remains without apparent change for several weeks, or even for two or three months. Then it begins to diminish slowly, but is generally still evident in the fifth or sixth month after infection, and now and then even for years afterwards. In rare cases the enlargement vanishes in two or three weeks. The long duration of enlargement renders this bubo a valuable sign of constitutional syphilis when the primary sore has disappeared. Again, the conspicuous enlargement of a group of glands may indicate the place of entry of the syphilitic poison when that is hidden.

Terminations.—In nearly all cases the glands revert to their natural state. Now and then suppuration takes place, not from the syphilitic change, but from ordinary irritation, and then produces a simple phlegmonous abscess. This is apt to occur in strumous persons. The glands enlarge still more, grow soft, and coalesce; presently matter forms in the thickened cellular tissue around the glands, and the further progress becomes that of scrofula.

Diagnosis.—This is generally easily drawn from the character of the swelling, aided by the presence of other syphilitic signs (hard sore, rash on the skin, &c.) This bubo may be confounded with chronic inflammatory enlargement, but in such cases the history and attendant symptoms remove doubt.

Prognosis.—Apart from its connexion with syphilis, the prognosis is good. The only untoward termination is scrofulous degeneration.

Treatment of Buboes.—1. The *syphilitic bubo* hardly needs treatment. It usually causes no trouble, and gets well independently of anti-syphilitic remedies. If tenderness or aching occur, rest and a few warm baths are sufficient. If suppuration take place the abscess must be incised and poulticed. The scrofulous degeneration is best met by anti-scrofulous remedies—

iodide of ammonium, or of iron, cod-liver oil, nutritious food, sea-air, and other tonics. Mercury, in $\frac{1}{20}$-grain doses of the bichloride, combined with the iodide of sodium or with solution of perchloride of iron, may be added to the treatment. Locally, the abscesses and sinuses must be emptied as fast as they form, and cleared by syringing with weak astringent lotions.

2. *Simple acute bubo* arising from any cause demands the same treatment, namely, that of acute abscess. In the early stages, antiphlogistics (rest in bed, the constant application of a cream made of equal parts of extract of belladonna and glycerine, warm poultices, fomentations, and baths, sometimes even leeches) are requisite. Caution must be observed in applying leeches if chancre be present. They should be used only in the early stage of congestion, lest the bites be converted by inoculation into chancres. Again, the leeches should be applied at the circumference of the swelling, so that they may be removed as far as possible from the centre where pointing is most probable. If suppuration arrive more speedily than was expected, and the bubo prove a virulent one, incision must be postponed as long as possible, and the leech-bites protected by collodion, carbolic lotion, iodoform, or other antiseptics.

When active congestion has ceased, the subsidence of the glands may be aided by pressure with a pad and spica bandage. Stimulating ointments and plasters, iodine, and similar preparations are of doubtful service, and may possibly re-kindle the inflammation. When pus has formed, it should be let out by a vertical incision at once. The proper drainage of the cavity should be insured by making the incision long ($\frac{3}{4}$ in. usually), and by placing a bit of lint or drainage tube between the edges of the incision during the first twenty-four hours. Early evacuation reduces undermining of the skin to a minimum, and prevents burrowing. When matter forms at several points, a small incision should be made at each fluctuating point. When free exit has been given to the pus, the groins should be well poulticed for two days, and then dressed with zinc ointment spread under a compress, the bandage of which, slackly applied at first, may be tightened as the swelling subsides.

3. The *chancrous bubo*, not being distinguishable during the inflammatory swelling and consequent suppuration from ordinary sympathetic bubo, requires the same treatment — calmants and an early single incision. By early incision the cavity of the abscess, subsequently the chancrous ulcer, is kept as small as possible; by a single incision the number of chancres is restricted. Occasionally, but only when the abscess has already undermined the skin, more than one incision is necessary. Caustics have no advantage over the knife for opening the abscess, while they make a larger gap. When the abscess has been opened and the chancrous nature is suspected, it should be well cleared at the time by injections of one part of carbolic acid to eighty of water, 5–10 grains to the ounce of nitrate of silver, of tartrated iron, or of some other astringent and disinfectant. This injection may be repeated three times in the first twenty-four hours; and constant drainage maintained by a drainage-tube and a compress of Lister's antiseptic gauze or boracic lint. Should these precautions fail to prevent the conversion of the abscess into a chancre, it must then be dressed as a chancre. It must be sedulously washed by injection twice daily, dried by careful mopping with bits of cotton-wool, and well dusted and packed with iodoform in powder; the whole cavity being loosely filled with pellets of cotton-wool, and compressed gently with a layer of lint and a bandage. Should this fail, as it sometimes will, caustic may be applied. The *caustics* most suitable are the strongest and most penetrating; such as Vienna paste, acid nitrate of mercury, Ricord's paste (powdered charcoal and the strongest oil of vitriol). To apply the caustic thoroughly the patient should be anesthetised. If the least part of the surface is left undestroyed, that will reinoculate the whole. Complete cauterisation is practically very difficult to accomplish, hence caustics should be reserved for the cases where iodoform, which is painless, fails. Overlapping bands of skin should be divided, that the dressing may be fairly applied.

Phagedæna.—When the ulceration by its obstinacy or by its rapidity deserves this title, plan after plan of treatment must be tried til' the destruction of tissue is arrested—caustics being reserved for the last. When the patient's general health is good, the ulceration seldom fails to yield to iodoform, applied thoroughly in the manner directed. While the nocturnal gnawing pain continues, the patient should be narcotised with opium or other narcotic. The cessation of pain is a signal that the eroding action has stopped. When iodoform alone is insufficient, the continuous warm hip-bath seldom fails. By it pain is at once arrested and healing soon set in motion. As continual immersion in a bath becomes extremely irksome in many cases, the phagedæna may be arrested by keeping the patient in water for sixteen hours every day, and allowing the night to be passed in bed—in this interval the wound should be carefully packed with iodoform. When the phagedæna is stopped, the bath may be discontinued and iodoform alone used. If the water-bath fail (and such a result has not yet happened during a considerable employment of this method at the Male Lock Hospital), caustics may then be used.

The strength of the patient, generally much exhausted, should be restored by tonics, good diet, stimulants, and other general means.

Abortive treatment of bubo.—This once favourite method of treating buboes has fallen into disuse as the varieties of bubo have been better understood. The chronically enlarged glands of syphilis have little or no tendency to suppurate, but subside spontaneously if let alone. Others only suppurate when freely irritated, hence the best abortive treatment for such, is to guard against the increase of irritation, and assuage that which exists by antiphlogistics. In the bubo virulent by absorption suppuration is inevitable. Thus, the sympathetic bubo is the only one which can be acted on by abortive treatment. To *antiphlogistics* may be added *counter-irritants*, but these are uncertain in their effect. Those least

open to objection are vesicants, and the form most beneficial is repeated 'flying' blisters. By this means a series of small blisters are produced round about, not over the swelling. Any other plan is most uncertain—painting the part with tincture of iodine, or other mild irritant, is simply waste of time. To enter at length into even a narration of the multitudinous ways in which irritants, vesicants, and even caustics have been employed would occupy much space to little purpose.

Compression is of great value for reducing indolent enlargement, or for removing the boggy condition of the groin where several abscesses have formed, with more or less undermining of the skin. It is useless for the syphilitic bubo and mischievous for the virulent bubo. The simplest and most effectual method of applying compression, is by a graduated compress of lint kept firmly in place by a spica bandage of calico, or of elastic tape. For abscesses, careful packing may be added to the compress. Each focus of pus must be laid open, and bridges or tunnels cut across, so that narrow strips of lint soaked in *liquor plumbi subacetatis* and lightly pressed between the fingers, to drive out the dripping excess of fluid, may be laid into the hollows and under overhanging borders of skin. The strips must be renewed every day at first, and the cavities well cleared by syringing with water. In a few days, when the discharge is very small, the strips may be left for three or four days unchanged. The first application is painful, but very soon an insensible crust is formed over the ulcerating surface, and fresh applications cause no discomfort. As soon as healthy granulations are formed, the plugging should be laid aside.

BERKELEY HILL.

BULBAR PARALYSIS. A synonym for glosso-laryngeal paralysis; derived from the pathological relation of the disease with the bulb or medulla oblongata. *See* LABIO-GLOSSO-LARYNGEAL PARALYSIS.

BULIMIA (*βοῦ*, a particle signifying excess; and *λιμός*, hunger). Excessive or voracious appetite. *See* APPETITE, Disorders of.

BULLÆ (*Bulla*, a bubble). *See* BLEB.

BURNS. The morbid effects produced by the direct application of excessive dry heat. *See* HEAT, Effects of.

BURSÆ MUCOSÆ, Diseases of.—Bursæ mucosæ are spaces in the connective, tissue lubricated with a small amount of serous fluid, and situated at points exposed to repeated pressure or friction. Structurally they are composed of a layer of condensed cellular tissue, fusing externally with the areolar tissue of the part, and lined internally with an imperfect layer of flattened endothelial cells, similar to those found in the pleura or peritoneum. Some bursæ, as that over the patella, that under the deltoid, those about the great trochanter, and many others, are constantly present; but new bursæ, equally perfect in their structure, may form at any part exposed to abnormal pressure and friction, as over the outer malleolus of a tailor, under an old corn, or over the head of the metacarpal bone of the great toe (*bunion*). Like the great serous cavities, bursæ are in direct communication with the lymphatics, and inflammatory products are consequently absorbed from them with great readiness, often giving rise locally to a diffuse inflammation of the surrounding cellular tissue, closely resembling phlegmonous erysipelas in appearance, and always accompanied by high fever.

Bursæ are liable to four forms of disease:—

1. **Acute inflammation and suppuration—Acute bursitis.**—This is usually the result of some more or less violent mechanical injury. It may occur in any bursa, but is most common in the bursa patellæ, those about the hip and over the olecranon, and in the small false bursa formed beneath an old corn, or in a bunion. The symptoms are those of acute inflammation generally, but the redness and swelling often extend a remarkable distance up and down the limb. Thus, a drop of pus beneath a corn may cause œdema and redness to the knee. The febrile disturbance is usually proportionately severe. About the trochanter the abscess may assume a chronic form.

TREATMENT.—Hot fomentations, and the application of glycerine and extract of belladonna (equal parts), may be of use. It is very important that pus should be let out early, or it may burrow extensively, especially about the knee. The antiseptic treatment, as recommended by Lister, will be found especially useful in the treatment of suppurating bursæ.

2. **Chronic Bursitis—Dropsy of the bursa** consists simply of an accumulation of serous fluid distending a bursa more or less tensely. The wall becomes somewhat thickened and opaque, but is otherwise unchanged. The fluid is clear, straw-coloured, and albuminous in character. The cause of the disease is usually repeated slight mechanical injury, but in some cases it may be due to some of those obscure conditions spoken of as 'rheumatism.' The symptoms are merely those of a collection of fluid in the situation of the bursa, perhaps accompanied by a feeling of weakness in the neighbouring joint. There is no pain or tenderness. The commonest form of this disease is the so-called housemaid's knee, but it is not unfrequent in the bursa of the popliteal space.

TREATMENT.—Avoidance of the mechanical injury, whatever it may be, which has caused the disease, is most important. The swelling may be painted with tincture of iodine twice a day for some weeks, or a series of small blisters applied over it. If this fail, a seton may be passed through and left in for a few days. Or an incision may be made into the swelling under antiseptic precautions, and a small drainage-tube introduced for a week or ten days. But before either of these means is adopted, care must be taken to ascertain that the bursa does not communicate in any way with the neighbouring joint. In the ham it is safer never to operate in any case, except perhaps by means of the aspirator.

3. **Chronic enlargement of the bursa, with fibroid thickening of its walls.**—This affection is most common in the bursa patellæ, but may occur in that situated over the tuberosity of

the ischium. The bursa becomes converted into a dense fibroid mass of almost cartilaginous hardness. On section it is found to be composed of concentric layers of dense fibroid tissue. There is usually a small central cavity containing a little fluid. The cause of this change, as of simple dropsy, is repeated mechanical injury of a slight nature. The only treatment is removal by the knife.

4. **Chronic enlargement of the bursa, with the presence in it of the so-called melon-seed bodies.**—In this form of disease, in addition to some thickening of the wall and accumulation of fluid in the bursa, small oval, flattish, smooth bodies of a white colour are found floating freely in its interior. These are similar in nature to those found in some forms of ganglion (*see* GANGLION). This condition is recognised by the peculiar soft crackling feeling perceived on palpation, combined with the ordinary symptoms of an enlarged bursa. MARCUS BECK.

BUXTON in Derbyshire. Simple thermal waters. *See* MINERAL WATERS.

C

CACHEXIA (κακὸς, bad, and ἕξις, a habit or constitution of body). SYNON.: Fr. *Cachexie.* Ger. *Kachexie.*

DEFINITION.—A chronic state of ill-health associated with impoverished or depraved blood, arising from mal-nutrition, persistent loss of blood-elements, or the presence of a morbific agent.

In such diseases as tabes mesenterica, lymphadenoma, and the like, the patients become cachectic from direct depravation of the blood, in consequence of disease of organs which are importantly concerned in its nutrition and elaboration. In other diseases persistent loss of blood-elements arising from chronic suppuration or from repeated hæmorrhages (especially observed in some uterine conditions) induces a cachexia which is well described by the term *secondary anæmia.* Again certain poisons introduced from without or nurtured within the body may produce marked cachexia. The syphilitic and malarial poisons are good examples of the first kind. Of cachexiæ produced by the presence of morbific agents which have been generated within the body we may instance those arising from defective elimination, as the uræmic and gouty cachexiæ from defective functional activity of the kidneys and liver. In the latter connexion it should be noted that, as has been hinted by Sir James Paget in reference to cancer, the malignant cachexia may arise from blood-contamination with the waste products yielded by the morbid growth in the process of its nutrition; such a growth not only abstracting material from the blood for its nutrition, but also contributing effete material to it.

It must be further observed that in the opinion of some of the best pathologists the term cachexia implies much more than the secondary anæmia consequent upon the ravages of a given local or general disease upon the system. It rather signifies the morbid constitution which *is* the disease, and which may precede its local manifestation. Thus we may have the cancerous cachexia, culminating in scirrhus of the breast, the tubercular cachexia in pulmonary tuberculosis, and the like. It is thus evident that with many observers the terms *cachexia* and *constitutional disease* have the same significance. R. DOUGLAS POWELL.

CACOPLASTIC (κακὸς, bad, and πλάσσω, I mould or form).—A term applied to products of inflammation which are more or less incapable of organisation.

CADAVERIC (*cadaver*, a dead body).—This word signifies 'belonging to the dead body;' and it is applied to the aspect, colour, odour, and other phenomena resembling those of death which are sometimes observed in the living subject.

CÆCUM, Diseases of.—The structural peculiarities and anatomical relations of the cæcum are specially favourable to the occurrence of the diseases to which this part of the large intestine is most liable, viz., (1) accumulation of the solid and gaseous contents of the alimentary canal, and (2) inflammation.

I. **Accumulations.**—Hardened fæces, biliary and intestinal concretions, foreign bodies, stones of fruit, balls of worms, lumbrici, and gases resulting from decomposition, are apt to collect in the cæcum, and cause varying degrees of local disturbance. Sometimes, as in elderly patients of torpid habit, the cæcum is found loaded with fæces, without inducing pain or other signs of inflammation. The right iliac region may be full and hard, and in it may be felt a well-defined, almost painless, doughy mass; the tumour is of the shape of the cæcum. As a rule, however, sooner or later the accumulation leads to one or more of the following results:—

(*a*) *Obstruction of the bowels.* This may be partial, as in the various degrees of constipation, or complete. When complete, it may even prove fatal without the cæcum or peritoneum exhibiting signs of inflammation. On the other hand, general peritonitis supervening, obstruction in the cæcum may be quickly obscured; still, however, the chief pain and tenderness will be found in the right iliac region. (*b*) *Pressure* on adjacent nerves, vessels, or other structures, producing numbness and œdema of the right leg, retraction of the right testicle and other symptoms. (*c*) *Inflammation* (typhlitis, peritonitis).

It is of clinical importance to bear in mind that the cæcum, when overloaded or enlarged, may occupy an unusual position, *e.g.* a site between

the right and left iliac regions, or it may descend somewhat into the pelvis and press on the urinary bladder.

Tympanitic distension of the cæcum is generally associated with some fæcal accumulation or obstruction in the colon or other part of the large intestine (*see* FLATULENCE).

II. **Inflammation.**—SYNON.: Typhlitis; Fr. *Typhlite*; Ger. *Blinddarmentzündung*.

DEFINITION.—Inflammation of the walls of the cæcum, liable to terminate in perforative ulceration; in peritonitis, local or general; or in inflammation and suppuration of the cellular tissue behind the cæcum (perityphlitis).

ÆTIOLOGY.—As *predisposing causes* may be regarded the anatomical peculiarities of the cæcum, favouring the accumulation of solids and gases liable to irritate; the causes of constipation and retention of fæcal matter, or of inertia of the large intestine; the period of childhood and adolescence; and previous attacks of typhilitis. *Exciting causes.*—Attacks of typhlitis have been ascribed to exposure to cold, to irritating ingesta, unripe fruit, &c. Inflammation of the cæcum may form part of an attack of enterocolitis or dysentery.

ANATOMICAL CHARACTERS. — Inasmuch as 'there are no cases on record of acute typhlitis proving fatal, in which post-mortem examination did not show the existence of perforation of the cæcum or appendix,'[1] we invariably find serious pathological changes complicating the appearances presented by simple inflammation of the walls of the cæcum.

In all cases the peritoneum investing the cæcum is involved, as indicated by opacity and injection; and generally adhesions exist between folds of the intestines, in the vicinity of the right iliac fossa. General peritonitis is usually found associated with perforation into the sac of the peritoneum, and the escape into it either of the contents of the cæcum, of an abscess in the cellular tissue behind the cæcum, or of a circumscribed peritoneal abscess.

SYMPTOMS.—Inflammation of the cæcum is met with either as part of a more extensive inflammation—*e.g.* enterocolitis, dysentery; or alone. In the former case its symptoms are merged into those of the more general affection to which it is subsidiary, while in the latter they are special and characteristic. Clinically, two classes of cases may be recognised:—(*a*) The inflammation is of the catarrhal type, does not end in ulceration, pursues a favourable course, and affects children more particularly. Probably it is strictly confined to the mucous lining of the cæcum. (*b*) The inflammation is more severe, is ulcerative, and is apt to terminate in perforation of the walls of the cæcum, and to induce tedious or fatal sequelæ. It would seem that all the coats of the cæcum are rapidly involved. This form of typhlitis is generally observed after the period of childhood.

Though typhlitis usually commences somewhat suddenly, most frequently there is a preliminary history of intestinal derangement, either in the form of obstinate constipation, or of catarrhal diarrhœa alternating with constipation. The characteristic symptoms are pain, and a tumour in the right iliac fossa.

The pain is continuous, and is increased by pressure and by movements, such as those induced by deep inspiration and coughing. The right iliac region becomes exquisitely tender and tense; and, to relieve the muscular tension over it, the patient reclines towards the right side, with the thighs drawn up.

In typhlitis from retention of fæces in the cæcum (Typhlitis stercoralis) there is a well-defined tumour from the first, which may attain a very large size; while in other cases there is often merely fulness in the early stage, and afterwards a distinct tumour. In all cases the tumour is of the shape of the cæcum, is sharply circumscribed, the lower part specially so, while the upper is less distinct, and may be traced into the ascending colon if this part be also inflamed. When the tumour arises from inflammatory thickening of the walls of the cæcum, it is less dull on percussion than when consisting of fæces. The abdomen is enlarged. Fever is usually slight or absent. The walls of the cæcum failing to contract, there is obstinate constipation, with tormina and vomiting. As a rule, in children vomiting does not become feculent. In typhlitis stercoralis intestinal obstruction may arise from the accumulation completely blocking the ileo-cæcal opening; then the paroxysms of pain become very severe, and the vomiting urgent and stercoraceous. Not uncommonly inflammation, though commencing thus in the cæcum with characteristic symptoms, extends all over the colon (*see* COLON, Diseases of); then constipation will give place to diarrhœa, and tenesmus with muco-sanguinolent evacuations will indicate a similar affection of the sigmoid flexure and the rectum.

The attack, having lasted from two or three to ten or twelve days, usually subsides by resolution—the bowels are copiously relieved, the vomiting ceases, and the pain, tenderness, and tumour disappear from the right iliac region. Even symptoms of intestinal obstruction which excite much anxiety may terminate thus favourably.

Not unfrequently, however, the course becomes tedious and dangerous. The accidents most to be feared are:—(1) Phlegmonous inflammation of the cellular tissue behind the cæcum (*see* PERITYPHLITIS); and (2) peritonitis. As a rule, inflammation of the peritoneum is confined to that portion covering the cæcum and adjacent structures; it may, however, become general from extension of this local inflammation, but more frequently from the bursting into it of the contents of the cæcum, or of an abscess.

PROGNOSIS.—Inasmuch as typhlitis without perforation almost invariably ends in recovery, the prognosis depends on the occurrence of inflammatory complications and sequelæ, and is, therefore, merged in that of perityphlitis. As a rule, perforative ulceration is less common during childhood than after the tenth or fifteenth year. If, notwithstanding the relief of constipation and the cessation of vomiting, the signs of local inflammation persist, ulceration of the cæcum, or the earliest stages of perityphlitis, may be suspected.

[1] Meigs and Pepper, *Diseases of Children*.

Treatment.—The indications are, (*a*) to relieve constipation and dislodge accumulations from the cæcum with as little irritation as possible, using laxatives combined with sedatives, *e.g.* calomel, colocynth, confection of senna, or saline aperients with opiates, and large warm enemata; the latter are indicated when aperients by the mouth set up or increase vomiting, or fail to relieve the bowels, or cannot be prescribed because of obstinate vomiting. (*b*) To subdue inflammation by rest, poultices, blisters, and opiates. The diet throughout should be fluid, consisting of beef-tea, milk, and such articles. All strong aperients are to be condemned—they are apt to increase the inflammation and the risk of perforation, and, while aggravating the vomiting, may fail to move the bowels. When local inflammation is severe, as indicated by great pain and tenderness, aperients by the mouth should be avoided, enemata used, opium given freely, as in peritonitis, and leeches may be applied.

III. **Dilatation, Contraction, and Perforation.**—The cæcum may be (1) *dilated* from accumulation within it of solids and gases, or from obstruction in the colon; (2) *contracted* from deposits (cancer, &c.), growths (polypi), or cicatrising of ulcers (tubercular, dysenteric); or (3) *perforated* from ulceration (simple perforating, enteric, tubercular, cancerous, dysenteric ulcer), or tearing of the wall by over-distension. Perforation may lead to different results, according to the part of the cæcum selected. When in the anterior surface, which is completely invested by peritoneum, a rapidly fatal peritonitis is most apt to follow; while in the posterior part, resting on the connective tissue of the iliac fossa, suppuration is usually the result.

George Oliver.

CALCAREOUS DEGENERATION.—A form of degeneration characterised by the deposit of earthy salts, especially of salts of lime, in the tissues. *See* Degenerations.

CALCULI (*Calx*, chalk).—Definition.—The term calculus is now applied to any kind of concretion formed in the ducts or passages of glandular organs; though older writers limited its employment to the designation of concretions met with in the kidneys and urinary bladder.

Varieties.—The following is a concise summary of the principal calculous concretions met with in the human body, given according to their alphabetical order.

1. **Biliary Calculi** vary considerably in size, number, form, and composition. In size they range from minute grains about the size of a pin's head to a mass as large as a hen's egg. The smaller they are, generally the larger is their number. Their form is very irregular—when solitary they are usually round or oval, when numerous they are generally more or less irregular in shape, their surfaces being flattened and facetted from compression. The colour is usually a blackish-green or brown, less frequently yellow or greyish-white. In consistence, some are soft like wax; others hard, dry, and friable. On section they will be found to differ widely—some being granular, and made up of sub-morphous particles without any apparent nucleus; others crystalline, the glistening white crystals (cholesterine) radiating from a central nucleus, which is frequently found to consist of inspissated bile. Biliary calculi consist almost entirely of cholesterine and bile-pigments, mixed with a variable proportion of insoluble organic matter and traces of the earthy phosphates. To separate the cholesterine, finely powder the gall-stone and thoroughly exhaust with ether; the ethereal solution on evaporation yields amorphous cholesterine. To obtain it in the crystalline form, it must be redissolved in boiling alcohol, which on cooling deposits it in characteristic, glistening, rhombic plates. The pigmentary matters can be obtained by exhausting the residue of the crushed gall-stone, from which the cholesterine has been removed, successively with water, alcohol, and dilute hydrochloric acid. The dried residue is then boiled with pure chloroform for some time, and the chloroform extract is distilled to near dryness, and several volumes of alcohol are added, which throws down bilirubin. Bilirubin thus obtained is an orange-red powder insoluble in water and ether, slightly soluble in alcohol, but very freely soluble in chloroform. On passing a current of air through an alkaline solution of bilirubin the solution acquires a green colour—biliverdin. According to Städeler biliverdin is formed from bilirubin by the addition of one atom of water in the presence of oxygen. A brown pigment, bilifuscine, can also be obtained by acting on bilirubin with strong sulphuric acid.

2. **Intestinal Calculi** are rare in man and carnivorous animals, but are not uncommon in herbivorous animals. They consist almost entirely of ammonia, magnesium phosphate, calcium phosphate, and calcium carbonate, deposited round a nucleus, generally a fragment of some undigestible material of the food, such as stones of fruit, husks of grain, or portions of bone. There is a kind of intestinal calculus occasionally met with among Scottish and Lancashire people, who use oatmeal largely as food, which is chiefly composed of the hairs and fragments of the envelopes of the oat, encrusted with calcium phosphate and carbonate. Magnesium carbonate when taken habitually and in bulk is apt to accumulate in the bowels and concrete there; there is now less risk of that danger since the fluid forms of magnesia have come into such general use.

3. **Pancreatic Calculi** are the rarest of all glandular concretions. When found they are generally numerous, being met with in the main duct, the accessory duct, and even in the smaller radicles. The size varies greatly, the largest that has come under the writer's observation being quite one inch in length. They are generally oval in shape, and their surface has frequently a worm-eaten appearance, of whitish colour, which when rubbed acquires an enamel-like lustre. When broken, the fracture often presents a white, glistening, porcelain appearance. One calculus analysed by the writer gave a percentage composition of organic matter ·24, fixed inorganic salts ·76. The bulk of the fixed inorganic salts consisted of calcium carbonate, calcium phosphate being present in much smaller proportion.

4. **Prostatic Calculi** consist essentially of calcium phosphate and calcium carbonate, though

incidentally traces of uric acid, calcium oxalate, and ammonio-magnesium phosphate may be found. They occur in three forms, namely, (*a*) small, rough concretions, from the size of a pin to a hazel nut; (*b*) irregular masses with porcelainous appearance; and (*c*) large regular concretions. The quantity of earthy matter that may be deposited in the prostate gland is often enormous. When the calculi are of the small variety, fifty or sixty may be present, and a gland may feel like a bag of nuts. The museum of the College of Surgeons contains a specimen showing the enormous size these concretions may attain. *See* PROSTATE, Diseases of.

5. **Salivary Calculi** are generally rough externally, irregular in shape, and are usually found near the orifice of the duct, which they obstruct. The nucleus frequently consists of some foreign body which has accidentally found its way into the duct, as a splinter of wood or a fragment of bone. Their chief component is calcium carbonate, of which they contain more than any other kind of concretion, and traces of early phosphates.

6. **Urinary Calculi** vary considerably in size, form, colour, and general appearance, according to their composition. The constituents that form these stones are uric acid, urates, cystine, xanthin, calcium oxalate, calcium phosphate, magnesium phosphate, ammonio-magnesium phosphate, calcium carbonate, and also concretions of blood and fatty substances (urostealith). Any of the above-named substances, combined with a varying proportion of organic matter, may constitute the sole ingredient of a calculus; more commonly, however, two or more are associated together. To fully ascertain the composition of the mass of the calculus it must be sawn across, and if made up of different layers, a portion of each layer must be analysed. *See* OXALIC, PHOSPHATIC, and URIC ACID CALCULI, and URINE.

PATHOLOGY.—The manner in which these concretions are formed, especially renal and urinary calculi, has long been a matter of speculation with physicians, some regarding them as of purely local origin, others endeavouring to show that they are the result of some peculiar diathesis, wherein uric acid, the phosphates, &c. are formed in the body so profusely, and are eliminated in such quantities as to be precipitated in the passages. The researches of Ord and Carter have thrown much light on this obscure subject. They have shown that the particles constituting the bulk of the calculus are not mere accretions, formed in the urinary passages by a process of chemical precipitation, in the presence of blood, mucus, &c.; but consist of structures, designated as 'sub-morphous'—granules, spheroids, laminæ, &c.—and which require considerable time for their formation. They have shown that this modification of form, *i.e.* the change from the crystalline to the sub-morphous type, can be artificially produced by allowing two saline solutions to intermix slowly through a colloid medium; as gum, albumen, &c.; the more slowly the mixture is effected and the denser the colloid, the more perfect is the change to the sub-morphous condition. On the other hand if the colloid medium is attenuated, and the admixture rapid, the crystalline form is more or less retained. The nature of this colloid medium has not been clearly made out. The fact that calculus rarely accompanies Bright's disease shows that the ordinary effusion of blood or albumin into the renal tubules does not furnish the necessary medium. Indeed if simple effusion of fibrin, or increased secretion of mucus, furnished the colloid, calculus, instead of being comparatively a rare disease, would be extremely common. Some authors have regarded the 'entangling mucus' as the product of a specific catarrh. Thus Meckel speaks of a stone-forming catarrh (*steinbildendend Katarrh*); and Dr. Owen Rees has pointed out that among the many evils attendant upon gout is 'a tendency of mucous membranes to secrete a viscid mucus, which modifies the ordinary crystalline character of uric acid, causing it to appear in agglutinated masses, which adhere to the sides of the urinary passages.' In speculations as to the origin of stone, too little attention has as yet been paid to the condition of the renal cells. These cells normally eliminate the urinary constituents; and it is not difficult to imagine that under certain conditions of vital impairment these substances may be retained and deposited, instead of being eliminated, the cell itself furnishing the colloid medium. The objection urged against this view is that recent observers have discovered no satisfactory signs of cell-structure in the matrix of calculi; but this objection can hardly be considered fatal, since the accretion of particles within the cell would gradually destroy the cell-structure. Professor Quekett, however, figured (*Med. Times*, vol. xxiv., p. 552, 1851) crystals of calcium oxalate and triple phosphate contained in cells taken from human tubuli uriniferi; and though his observations have not been confirmed by others, still the accuracy of his work has never been questioned, and it may be when the tubuli uriniferi of persons dying of calculous affections come to be more frequently examined by pathologists, cells containing calculous constituents at an early stage of deposition may be observed—that is, before the cell-wall is destroyed. It is a remarkable fact that calculous deposit commencing in the kidney tubules is rarely met with in the convoluted portion of the tubule, but invariably occurs at the apices of the mammillary processes, the extremities of the ducti papillares. Now less blood circulates through this portion of the kidney than through any other part of it, and moreover in the ducti papillares, the basement membrane (tunica propria) disappears and the wall consists of epithelium alone. May not these anatomical differences render the cells of this part of the tubule more liable to calculous deposit—in short, to undergo calculous degeneration?

CALIPERS.—An instrument employed for measuring diameters, more especially in medicine the diameters of the chest. *See* PHYSICAL EXAMINATION.

CALVITIES (*calvus*, bald). SYNON.: *Alopecia calva*. A synonym for baldness. *See* BALDNESS.

CANARIES, The (Teneriffe), in North-east Atlantic Ocean. Mean temperature in winter, 64° to 85°. Warmer, drier, but more variable, than Madeira. East winds from Africa.

CANCER (*Cancer*, a crab).—Definition.—The word cancer is without histological meaning. We find it and its synonym, *carcinoma*, used as long ago as the time of Hippocrates, and the latter term was then, as is the former at the present day by the vulgar, applied to any new growth of a malignant character. The name originated in the large ramifying veins and puckered furrows which spread from a cicatrizing cancer that is involving the skin. When the broad distinction between the epithelial and connective-tissue type of tumours was established by Virchow and others, it was decided to retain the word *cancer* as the name for the more malignant or epithelial growths; while the equally meaningless but less formidable word *sarcoma* has been from this time confined to those tumours which have connective tissue for their type. *See* Tumours.

In this sense of the word the cancers form a class which is, on the whole, easily distinguished by definite microscopical and clinical characters, but at two points, at least, the difference from simpler growths is almost imperceptible. First, as a matter of accident, one sarcoma (the alveolar) resembles a cancer so closely in microscopical structure, that it is impossible to distinguish between them without reference to clinical facts; and, in the second place, as cancers are essentially depraved modifications of epithelial, epidermic, or glandular structure, they may be found to differ so slightly in histological characters from simple hypertrophies, that the fact of ultimate malignancy is often all that can decide between, say, a papilloma and an epithelioma, a glandular cancer of the rectum and a simple polypus, or a scirrhus of the breast and a chronic mammary tumour.

Histological Structure. — Histologically, cancers are distinguished by consisting partly of cells of an obviously epithelial origin and partly of connective tissue. The connective-tissue forms alveolar spaces, and may vary in structure from a loose fibro-cellular material to strong and old fibrous tissue. The alveolar spaces communicate with each other and contain the epithelial cells. These vary much in shape, size, and arrangement, but are always easily separable from the surrounding connective-tissue, while they are never separated from one another by a stroma of any sort.

Clinical Characters.—Clinically, cancers are distinguished by the structures in which they originate; by the method of their recurrence and their mode of growth; as well as by a few characteristics apparent to the eye and touch.

Seat.—As their nature would have rendered almost certain *a priori*, cancers probably never originate except in connection with epithelial or epidermic structures—*i.e.*, in skin, mucous membrane, or secreting glands; but as the epidermis and epithelium, the original upper and lower layers of the embryo, are widely diffused throughout the body, and often intimately associated with the descendants of the cells of the middle layer, it is not surprising that primary cancers have been described as occurring in organs which have their origin from connective-tissue only. Such are the instances of primary cancer of bone and lymphatic glands the possibility of the occurrence of which may be at present considered undecided.

Recurrence.—The first recurrence is almost without exception in the lymphatic glands, which collect their supply of lymph from the seat of the original tumour; when this has occurred the process may be repeated in the next proximal lymphatic glands, or numerous distinct tumours may appear in different parts of the body; but if a single growth occur in another locality without previous glandular enlargement the case may probably be looked upon as a double primary development. A soft cancer may burst into the abdominal cavity, where its small particles may stick to various parts of the peritoneum and form the starting points of new growths (disseminated cancer of the peritoneum); it is probable that a similar seeding may take place into the lungs when an ulcerated epithelioma projects into the trachea.

Mode of growth. — Cancers increase in size by infiltration of the surrounding tissues, and this gives rise to the very important clinical facts that they are not enclosed by a capsule like many simpler growths, and that they have a great tendency to implicate the skin and cause ulceration.

Naked-eye appearances.—The contraction of the connective-tissue forming the alveoli in its advance towards fibrous tissue gives rise to puckering of the surrounding skin; and the looseness of the connection between the epithelial and connective-tissue elements causes a milky juice consisting of the former to escape on scraping a recent section. This characteristic was made much of by our predecessors before the word *cancer* had lost its inclusive meaning; we know now that many rapidly growing *sarcomas* yield a similar juice, but in less abundance than cancers; and thus it has come to pass that a milky juice is now more diagnostic of the malignancy than of the genetic origin of the growth.

This completes the list of the signs by which cancers may be distinguished from other tumours. Tables have been published to show the relative frequency with which cancer attacks different organs; they are not upon the whole trustworthy, and this question will be best considered in discussing the subdivisions of the genus.

Classification.—The subdivisions of cancers are as follows:—

Hard cancer or *Scirrhus.*	Glandular type
Soft cancer or *Encephaloid.*	
Cylindrical Epithelioma.	Epithelial and Epidermic type.
Lobular Epithelioma.	
Colloid.	

Typical hard and soft cancers stand obviously at opposite ends of one series which is built upon the type of a secreting gland: between the two are an infinitude of intermediate stages. The two forms of epithelioma are, quite as evidently, monstrous growths of skin or mucous membrane. Colloid is probably the result of degeneration of any one of the other forms. Besides these, other varieties are often mentioned which do not justify a more complicated classification; amongst these are tumours, which though of nearly normal glandular structure are nevertheless malignant,

and those which have received the names *Melanotic, Teliangiectasic, Osteocancer*, &c.

Diagnosis.—The diagnosis depends upon the clinical characters of the several groups. That of an advanced case of cancer is generally easy; in the early stages it is mostly impossible.

Prognosis.—The prognosis is always bad, especially in encephaloid cancer, but least so in epithelioma; this suggests the much-debated question of the constitutional nature of the disease. If in its origin a cancer be purely local, early removal ought to effect a permanent cure; but if there be at the bottom a constitutional taint, a reprieve should merely be granted until a suitable fresh irritation arise. There is probably some truth on both sides. The cancerous cachexia is often spoken of; it depends chiefly, if not altogether, on the weakening effects of the discharge after ulceration has taken place; mental worry may have some share in causing it; but it must be remembered that cancerous patients, who, before they are attacked, are frequently amongst the most robust, often retain their health for a remarkably long time.

Course.—The course of a cancer depends upon its seat, and the symptoms must accordingly be sought amongst the articles on diseases of special regions. If, however, life be not shortened as a result of interference with the functions of the organ attacked, death is caused either by marasmus—the result of prolonged suppuration and pain, or by extensive or repeated hæmorrhages. The rate of progress is more slow as age advances.

Treatment.—The treatment of cancer in the early stages can only be undertaken by the surgeon, and the reader is accordingly referred for information on this head to surgical textbooks; in the later stages the physician may be called upon to treat symptoms, but up to the present time all the specifics introduced either by regular practitioners or by charlatans have proved quite inefficient, if not actually harmful.

We shall now discuss the varieties of cancer.

I. Scirrhus.—Scirrhus, as its name implies, is amongst the hardest of tumours, if bony growths be excepted. Its hardness, as compared with soft cancer, depends upon the larger proportion which the alveolar stroma bears to the contained cells; and this is probably the consequence of the soil in which the tumour originates, and the rapidity of its growth, rather than of any specific difference between them.

Seat.—The female breast is the most common seat for scirrhus, but it also occurs in the stomach, uterus, tongue, œsophagus, and the liver and other glands, and it has been described as primary in the prostate, testicle, skin, and other structures.

Naked-eye appearances.—A section through the centre of a matured hard cancer of the breast presents to the naked eye well-marked and constant appearances, which, with the exception of such peculiarities as are due to the situation, will serve as a description of such a tumour occurring elsewhere. These are clearly explained by the microscopical arrangement, and when looked at by the light which it affords, fully account for all the clinical characters. The knife passes through it with a creaking noise, and the cut surfaces are at once hollowed in the centre. There is not a sharp edge to the growth, and the circumference is of a greyish or pinkish white tint, projecting a little above the surrounding tissues, into which it sends small lobular prolongations; the hollow centre is very hard and of a glistening white colour. Scirrhus is evidently fibrous in structure, and receives from all quarters fibrous bands, which often pass far out into the fat of the breast or the skin, and some of which can nearly always be traced to the principal milk-ducts. Between the centre and the edge is the greater part of the tumour, on the whole of a pinkish-yellow colour, but notably pink and soft externally, and yellow and hard internally. The surface yields a milky juice on scraping, and may show some of the following appearances, which are, however, accidental: round the circumference little masses of healthy fat may be included, though this but rarely happens; cysts containing grumous grey or red fluid may have formed by the breaking down of the new growth or by hæmorrhage; or such a hæmorrhage may have resulted in patches of yellow or even black pigmentation.

Microscopical appearances.—Without discussing the merits of the opposing theories as to the origin of cancer-cells, the following may be taken as the undoubted microscopical appearances of scirrhus; the grey outer layer is made up of indefinite smallish round cells, resembling white blood-corpuscles, infiltrated through the tissue into which the growth is spreading, amongst which are scattered a few which have the appearance of epithelial cells. The next or pink layer represents full development and shows fibro-cellular stroma, enclosing large epithelioid cells, and containing a copious supply of vessels. In the third or yellow layer the stroma has become fibrous and the cells are undergoing fatty degeneration; and in the inner white centre the cells are replaced by indefinite masses of granular débris, and the stroma consists of firm and old fibrous tissue. *See* figs. 125, 127, and 126.

The relation of these appearances to the clinical peculiarities of scirrhus is as follows: the excessive hardness is explained by the great development of fibrous tissue; the peculiar indefiniteness of the edge, and the tendency to involve the skin and ulcerate, by the manner of growth; while the puckering, retraction of the nipple, and indirectly (from the manner in which cutaneous nerves are involved) the pricking and shooting pains, are due to the contraction or cicatrization of the stroma. To the latter is also due a very important but not generally recognized diagnostic character of an early scirrhus, namely, that long before the skin is involved it is seen to be dimpled when gently moved to and fro over the growth. A scirrhus which has involved the skin forms a purplish-red, flattened, and shining tumour, covered with small veins and tender to the touch; the ulcer which results from its breaking down is ragged, with a hard base and hard irregular undermined edges, and a dirty surface covered by knobby masses of pseudo-granulations, which have a great tendency to bleed and often slough. As it is often removed it often returns in the scar. When occurring in the liver it is

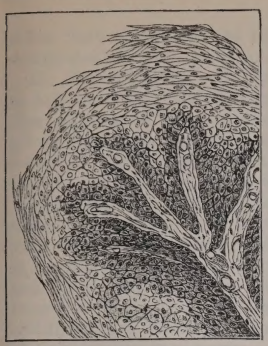


FIG. 117. Papilloma of Soft Palate.

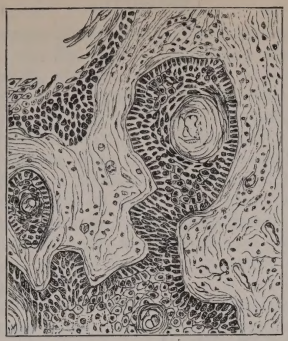


FIG. 118. Epithelioma of Lip.

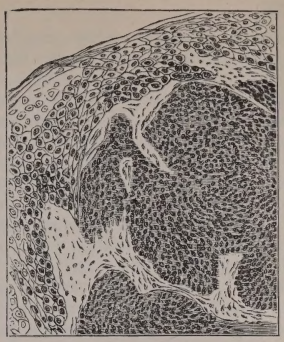


FIG. 119. Edge of Rodent Ulcer.

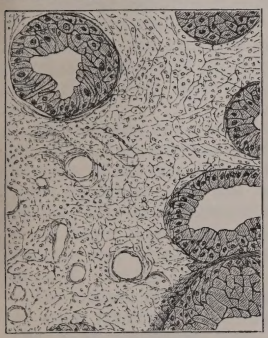


FIG. 120. Simple Polypus of Rectum.

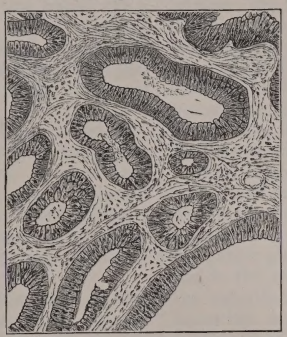


FIG. 121. Columnar Epithelioma of Intestine.

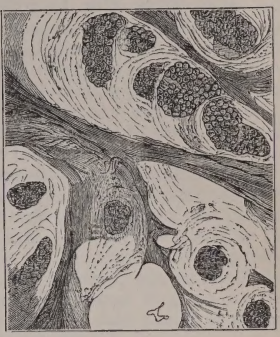


FIG. 122. Colloid of Breast.

FIG. 123. Cancer of Liver (Scirrho-encephaloid).

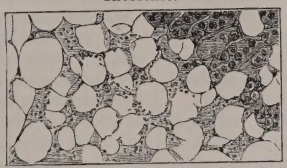


FIG. 125. Scirrhus Infiltrating Fat.

FIG. 127. Scirrhus of Mamma.

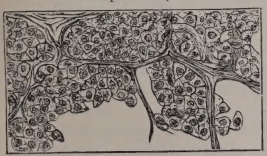


FIG. 124. Encephaloid Cancer.

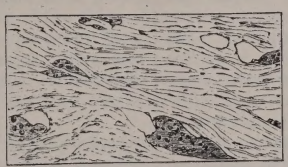


FIG. 126. Cicatrizing Cancer.

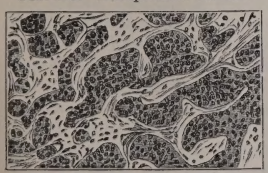


FIG. 128. Adenoid of Upper Jaw (Benign).

FIG. 130. Adenoid of Breast (common type).

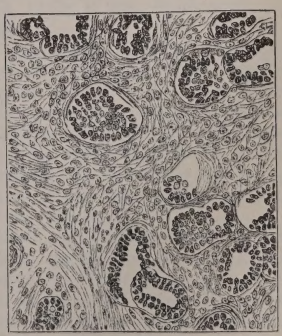


FIG. 132. Adenoid of Breast (Adeno-sarcoma).

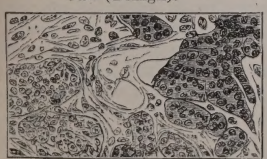


FIG. 129. Ulcerated Adenoid of Parotid (Malignant).

FIG. 131. Adenoid of Breast (epithelial element in excess).

Drawings illustrating a Series of Tumours of the Epithelial Type. All drawn to the same scale (× 87 *diameters*).

softer than elsewhere, and the name of scirrhoencephaloid is often given to it. *See* fig. 123.

II. Encephaloid.—Encephaloid, medullary, or soft cancer, so named from its usually brain-like appearance and consistence, is softer and grows more rapidly, and is more frequently observed in internal organs than scirrhus, often indeed forming enormous intra-abdominal tumours.

Seat.—It has hitherto been observed as primary in the salivary and mammary glands, testicle, ovary, and prostate, the thyroid body, and in the mucous membrane of the nose, the liver, and the stomach. It has with some degree of looseness been sometimes called the cancer of childhood by those who consider scirrhus as almost peculiar to old age.

Naked-eye appearances.—To the naked eye a fresh section usually presents a convex surface; it is whitish, but generally mottled by coloured patches, the result of old or recent hæmorrhages, and yields very copiously a milky juice on scraping.

Microscopical appearances.—Encephaloid cancer differs from scirrhus only in the relative proportions of the two chief factors. The cells are more numerous and are contained in larger spaces; they are sometimes small, but generally much larger than in scirrhus; and the stroma is delicate and fibro-cellular and very small in amount. *See* fig. 124.

Its method of extension is the same as that of other members of the class. It is by far the most malignant form of cancer, because of its rate of growth and recurrence, and the rapidity with which it causes general cachexia.

Epithelioma.—Lobular epithelioma, epithelial cancer, or cancroid, develops in connection with skin and mucous membrane, and though consisting essentially of squamous epithelium, may start from a part which is covered by the cylindrical variety. It occurs near the natural orifices of the mucous tracts — as, for example, on the mouth and tongue, anus, penis, or vulva; but also at other parts of the skin — as on the scrotum (chimney-sweep's cancer) and at the upper end of the œsophagus. The history of a local irritation is often obtainable, but more frequently nothing of the kind can be discovered.

Naked-eye appearances.—The first appearance is that of a pimple, which soon breaks down in the centre, forming a small sore. When fully developed there is an irregular ulcer with an extensive hard and nodular, generally inflamed base and circumference; the edges are abrupt or undermined, and the floor grey or reddish, very uneven, discharging a foul pus, and with a great tendency to bleed. As a rule there is considerable pain, and the proximal lymphatic glands are very generally enlarged. A section to the naked eye shows a number of minute cylinders of yellowish-white colour, cut sometimes longitudinally, sometimes transversely, fusing together into an indefinite mass superficially, but more or less discrete below, and infiltrating amongst the subjacent tissues. On squeezing the section little nodules like sebum appear on the surface.

Microscopical appearances.—The cylinders or lobes of epithelioma are found to be made up of squamous epithelium, which generally exhibits in parts a crenated margin (Max Schultze's spine-cells). As in the skin, the deeper—that is the circumferential—layer of cells in each lobe, which are the youngest, are roundish or oblong, with large nuclei, and staining readily; further in, the cells are larger and flatter, and in the centre are found the well-known globes or nests. These were considered at one time as peculiar to epithelioma, but are now known to occur in warts and corns; they consist of onion-like arrangements of epithelial cells, varying much in size and the number of concentric layers, and containing in the centre sometimes an amorphous mass, sometimes large and irregular cells. The tissues beneath and between the lobules are infiltrated with small cells, and often contain in sections what appear to be isolated masses of epithelium; these are, however, the ends of divided divergent lobules. Opinions differ as to the exact starting-point of an epithelioma, the share which the sweat- and other glands take in it, and also as to the rationale of the formation of the globes. *See* fig. 118.

Epithelioma seems to be more local in its nature than other cancers—that is, a complete and early removal has not unfrequently given the patient a long lease of life. It recurs, as a rule, in the lympathic glands, which inflame and suppurate, and in the scar, and generally proves fatal from the constitutional disturbance it gives rise to. Later but more rarely it may appear in the internal viscera, bones, &c.

Cylindrical Epithelioma.—The cylindrical epithelioma—badly named adenoid or glandular cancer—is specially the cancer of the alimentary mucous membrane, but may occur in the bladder and elsewhere.

Naked-eye appearances.—To the naked eye it forms at first a prominent tumour in the interior of a viscus, which has a tendency like other cancers to ulcerate and involve surrounding tissues, so that the mass may reach an enormous size, and may even make its appearance through the skin. To the naked eye a section is generally whitish and has a granular appearance, which is given to it by the tubules of which it is made. It frequently causes death by obstruction of the bowel, but if it last sufficiently long, it recurs unaltered in the lymphatic glands, and then in the viscera and other parts of the body. It is not unfrequent to find recurrences in the liver with little if any implication of lymphatic glands.

Microscopical appearances.—Cylindrical epithelioma consists essentially of irregular tubules lined with columnar epithelium in one or more layers, which are the much overgrown crypts of Lieberkühn, and differ in microscopical structure from simple papilloma of the digestive tract only in the greater irregularity of the cells and in the larger proportion of connective-tissue stroma between the tubes. *See* fig. 117.

Colloid.—Colloid, or alveolar cancer, named from its jelly-like appearance, has given rise to much discussion in reference to the question whether it is developed originally in its mature form, or whether it results from the degeneration of one of the classes of cancer described above. The latter view is that most

widely held, though it must be allowed that epithelioma seldom degenerates in this way, and also that the colloid change usually takes place *pari passu* with the growth of the tumour.

Seat.—Colloid cancer is found most frequently in the abdominal viscera and peritoneum, but may occur elsewhere, as in the breast. Its malignancy is great, but is shown chiefly by the rapidity with which it involves surrounding tissues; it thus forms primary tumours of enormous size, but as a secondary growth is less common; it does, however, occur in lymphatic glands and other parts. It causes death in most cases by interference with the functions of the organs attacked.

Naked-eye appearances.—Colloid cancer consists to the naked eye of a mass of semi-transparent jelly, varying slightly in colour, but mostly pale yellow: this is intersected by delicate white fibrous bands, forming alveolar spaces of different sizes, visible to the naked eye. The consistence of the growth depends upon the relative proportions of these two constituents.

Microscopical appearances.—The bands are found to be actually fibrous; the contained jelly is arranged in concentric laminæ between which are minute granules, and in the centre of which is a granular mass, sometimes quite indefinite, but often showing clearly that it consists of the remains of altered cells. These cells are seen in the more recent parts of the growth to be the subjects of colloid degeneration. The source of the colloid material must be considered still undecided; that some of it is formed by the cells is certain, but it is not equally clear whether the stroma takes any share in its deposition. *See* fig. 122.

Conclusion.—Our knowledge of the pathology of new growths is undergoing a process of rapid evolution. While, therefore, the writer has endeavoured in this article, and in that on Tumours, to represent the opinions most widely accepted at the present day, he is conscious that in a very short time these opinions may require considerable modification. R. J. Godlee.

CANCRUM ORIS (*Cancrum*, a sore; and *oris*, of the mouth). Synon.: Gangrenous Stomatitis; Noma; Fr. *le Nome*; Ger. *Wasserkrebs*.

Definition.—A phagedænic ulceration of the cheek and lip, rapidly proceeding to sloughing.

Ætiology.—Cancrum oris is usually seen in delicate, ill-fed, ill-tended children; and in these subjects it is commonly a sequela to one of the eruptive fevers. Formerly it used sometimes to be due to excessive doses of mercury.

Symptoms.—The disease commences by swelling and tenderness near the angle of the mouth, and if at this stage the mucous membrane is examined, it will usually be found that there is some superficial ulceration on the inside of the lip or cheek—that is, ulcerative stomatitis. From this slight beginning the disease rapidly advances. The soft tissues become much swollen, brawny, shining, and red. Presently a livid spot makes its appearance in the centre, and the surrounding part becomes purplish or mottled. If the patient can open his mouth sufficiently to give a view of the gums, they will be seen to be red, congested, spongy, and bathed with a profuse and fœtid saliva. The livid tissues of the cheek rapidly slough, the disease perhaps involving the lip, or spreading to the gum, laying bare the alveolar processes, and loosening the teeth. This local affection is attended by a high degree of pyrexia, and by great prostration.

The disease is very fatal. Rilliet and Barthez state that not more than one in twenty cases recover.

Treatment.—This consists in the application of strong nitric acid to any points where the ulceration and sloughing are spreading. Poultices should be kept constantly on the cheek, and from time to time the sore should be syringed with a disinfecting lotion. The constitutional treatment consists in the administration of a full amount of beef-tea, milk, eggs, &c., with a moderate allowance of alcoholic stimulants, as well as bark, ammonia, and other suitable tonics. Regular and systematic administration of food and medicine is of the utmost importance; and if the patient is unable to swallow, nutritious enemata must be used regularly.

W. Fairlie Clarke.

CANITIES (*canus*, hoary or greyhaired).—Whiteness or greyness of the hair. *See* Hair, Diseases of.

CANNES in France, on the Mediterranean coast. A dry, bracing, fairly mild winter climate. Exposed to N.W. Abundant accommodation, both near and at some distance from the sea.

CANTHARIDES, Poisoning by. *See* Appendix.

CAPE OF GOOD HOPE.—A warm, generally dry climate, but very variable, and liable to sudden storms. Living dear, and locomotion difficult.

CAPILLARIES, Diseases of.—The morbid conditions of the capillaries may be described in the following order:—1. Fatty Degeneration. 2. Calcareous Degeneration. 3. Albuminoid Degeneration. 4. Pigmentation. 5. Changes in Inflammation. 6. Dilatation. 7. Narrowing and Obliteration. 8. Thrombosis. 9. Embolism. 10. Rupture. 11. The New Formation of Capillaries. 12. Capillaries in New Growths and Tubercle. 13. Changes in the Perivascular Space and Sheath. 14. Teleangiectasis.

1. **Fatty Degeneration** is the most common disease of the capillary-wall, and is frequently associated with fatty degeneration of the surrounding tissues. The cause of this change in the protoplasm of the capillary is, as elsewhere, interference with nutrition, and especially with oxidation. It is accordingly found in morbid conditions of the blood; in interference with the blood-supply; and in lesions of the nervous system. The microscopical characters of the early stages of fatty degeneration when it affects the capillaries are not peculiar; in advanced stages the diseased vessels may present the appearance of opaque granular cords; and the lymphatic sheaths of the cerebral capillaries are sometimes found, under such circumstances, filled with oil-globules and fatty cells. A frequent termination of the disease is rupture and hæmorrhage. Fatty

degeneration of the capillaries occurs most frequently in the nervous centres, in the kidneys, in certain tumours, and in the products of infarction and inflammation.

2. **Calcareous Degeneration** is rare in capillaries.

3. **Albuminoid Degeneration** affects the Malpighian glomeruli in the early stage of albuminoid disease of the kidneys. In other parts of the body the capillaries are less subject to albuminoid change than the small arteries.

4. **Pigmentation.**—Pigmentary granules may sometimes be found in the walls of capillaries, but they more frequently occupy the perivascular space. In either situation pigmentation is the result of chronic congestion or inflammation, or of hæmorrhage.

5. **Changes in Inflammation.**—The changes of the capillaries of an inflamed part constitute an important factor of the process of inflammation. *See* INFLAMMATION.

6. **Dilatation** of capillaries, which is one of the changes in inflammation just referred to, may become permanent if the process be chronic. Changes in the nutrition of the capillary-wall, combined with disturbances of the circulation, such as increased pressure, produce local dilatation or **Aneurism** of the vessels and subsequent rupture. This is one form of *miliary aneurism* as it occurs in the brain.

7. **Narrowing** and **Obliteration.**—Narrowing of capillaries may be temporary, as in inflammation; or permanent, from external pressure, or from interference with the blood-supply. Narrowing may proceed to complete obliteration.

8. **Thrombosis** commonly occurs in capillaries as a consequence of embolism or of thrombosis in the associated arteries or veins. Less frequently the coagulation of blood is primary, and is due to one or more of the usual causes of thrombosis, namely, feebleness of the circulation and alteration of the blood.

9. **Embolism.**—The phenomena of ordinary embolism in a great measure affect the capillaries corresponding with the obstructed artery. But besides this change, capillaries are themselves subject to embolism, or impaction of particles within them. The products of inflammation or degeneration, pigment-particles, oil or fat drops from the marrow of fractured bones, organisms, and various substances artificially introduced into the circulation, have been discovered obstructing the capillaries in different instances. All the possible results of embolism in large vessels may follow, according to circumstances; and in the case of the cerebral vessels definite symptoms are believed by some to result, such as delirium and choreic movements. *See* CHOREA.

10. **Rupture.**—Three circumstances specially determine the occurrence of this lesion of capillaries, namely, disease of the vessel-wall, increase of the blood-pressure, and a 'terminal' distribution of the branches of the artery that supplies them. The most common diseases of the wall are fatty degeneration and aneurism. The blood-pressure rises within the capillaries of any part in ventricular hypertrophy, in increased tension of the arteries of other parts, and in venous obstruction. When an artery is 'terminal,' that is, unprovided with other anastomoses than through its capillaries, no lateral relief can be afforded in sudden and excessive rises in the force of the circulation. For these several reasons, rupture of capillaries is most frequent when the vessel-walls have been weakened in the fatty degeneration of senile decay, in septicæmia, inflammation, purpura, fever, and scurvy; in chronic Bright's Disease, with increased blood-pressure; and in such organs as the corpus striatum, retina, spleen, kidney, villi, and skin. Disturbances in the pressure of the air within the chest powerfully influence the occurrence of capillary-rupture in the respiratory tract. When a capillary-wall gives way, the blood is extravasated either on a free surface, constituting hæmorrhage; into the substance of the tissues around; or along the lymphatic sheath of the ruptured vessel, where it gives rise to the appearance that has been described as *dissecting capillary aneurism*.

11. **New Formation of Capillaries.**—Capillaries grow or develop in nearly all forms of new growth, whether inflammatory or otherwise. The young capillaries are derived either from cellular buds upon previous capillaries, which become hollowed by the blood-pressure; from anastomosing exudation-cells, or connective-tissue corpuscles; or, in some cases, from the parallel disposition of exudation-cells.

12. **Capillaries in New Growths and Tubercle.**—The capillary-walls are believed to play an important part in the production of certain forms of new growth. *See* TUMOURS and TUBERCLE.

13. **Changes in the Perivascular Space and Sheath.**—The perivascular or lymphatic sheath, which probably envelopes all capillaries, is liable to certain morbid conditions, which are chiefly secondary to changes in the vessel within it. Thus the space may become filled with blood from escape of the corpuscles by rupture or otherwise; with leucocytes in inflammation, with oil-globules and fatty corpuscles in degeneration of the wall; with pigment-particles; or with serum in disturbances of the circulation. The calibre of the perivascular canal, which varies inversely with that of the contained capillary, may thus be increased, and present uniform or irregular dilatation.

Changes in the *outer* sheath, or wall of the lymphatic space, have also been observed, including fatty degeneration of the lining cells and hyaline thickening.

14. **Teleangiectasis.**—At least one form of vascular tumour consists of a local over-growth of capillaries, which are both enlarged and multiplied. *See* TUMOURS. J. MITCHELL BRUCE.

CAPILLARY BRONCHITIS.—Inflammation involving the minute bronchial tubes. *See* BRONCHI, Diseases of.

CARBOLIC ACID, Poisoning by. *See* POISONS.

CARBONIC ACID, Poisoning by.—The inhalation of carbonic acid causes injurious or fatal results, according to the length of time and degree of concentration. Carbonic acid accumulates in large quantities, almost undiluted, in pits, cellars, wells, mines (especially after

explosions, constituting what is called choke-damp), volcanic grottoes, fermenting vats, lime-kilns, &c. A continuous contamination of the atmospheric air with carbonic acid goes on from the respiration of animals and the combustion of fuel. The gradual exhaustion of oxygen and proportionate accumulation of carbonic acid in ill-ventilated apartments is one of the factors of the evil results of bad ventilation, but not the only one, as other animal exhalations contribute largely to the result.

As a rule excess of carbonic acid means corresponding deficiency of oxygen in the atmosphere, and the proportion cannot exceed 10 per cent. without rapidly fatal results ensuing; but much less than this causes injurious, and even the like consequences if long inhaled; and less than 2 per cent. cannot be breathed for any length of time with impunity.

If the amount of oxygen be not correspondingly diminished, carbonic acid if present in sufficient quantity in the atmosphere respired will still act fatally. Thus Bernard found that a bird died instantaneously in an atmosphere of equal parts of oxygen and carbonic acid, and Snow found that 20 per cent. of carbonic acid in an atmosphere containing the normal proportion of oxygen soon proved fatal to small animals, and that even 12 per cent. might cause death after a longer interval.

Symptoms.—Undiluted carbonic acid is not readily inhaled, as it tends to induce spasm of the glottis, but immersion in such an atmosphere is rapidly fatal. It seems to act like a narcotic. The patient falls down prostrate and insensible, and death occurs almost immediately. This effect is seen occasionally when labourers incautiously descend an old well, or when miners enter a region filled with choke-damp. Not unfrequently more than one fall victims, as one goes to see what has happened to the other and meets the same fate.

When the carbonic acid is more diluted the symptoms are headache, giddiness, and sense of oppression; followed by drowsiness, and singing in the ears; and passing into a condition of stupor and insensibility, with stertorous breathing and muscular prostration, death usually occurring quickly and without convulsions. If the excess of carbonic acid corresponds with deficiency of oxygen, we have in addition to the essentially narcotic effects of carbonic acid, the dyspnœa and other symptoms of asphyxia (*see* Asphyxia).

Post-mortem appearances. — These are largely those of asphyxia, viz., a general engorgement of the venous system. This is generally seen in the brain, more frequently than in asphyxia pure and simple. The blood is dark-and fluid. The hæmoglobin is completely reduced. Animal heat is said to be retained long after death, and rigidity is well-marked and enduring.

Pathology.—As has already been said, carbonic acid does not act merely as a negative asphyxiant by taking the place of oxygen, but has a distinctly toxic narcotic effect. Very frequently in cases of poisoning by carbonic acid there is a combination of asphyxia, essentially due to defect of oxygen, with the narcotic symptoms due to carbonic acid.

Treatment. — 1. *Prophylactic.* — Caution should be exercised in exploring wells, mines, &c., where there is likelihood of the accumulation of carbonic acid. The introduction of a lighted candle is a rough and ready test of considerable value. The mere fact of a candle continuing to burn in an atmosphere is no test of its being respirable with impunity, for a candle will burn in an atmosphere containing 10 per cent. of carbonic acid if the oxygen is present in the normal amount, and the presence of an amount of carbonic oxide sufficient to cause death will not materially affect the flame. If carbonic acid reaches the proportion of 16 per cent. the candle will be extinguished, however. If a candle is extinguished, then certainly the atmosphere cannot be breathed, and therefore the test is of sound practical value. If carbonic acid does exist it should be expelled by creating a draught of some kind. Thus wells may be swept by some such contrivance as an inverted umbrella, and a stream of air can be directed into enclosed spaces.

2. *Restorative.*—Artificial respiration and its various accessories are needed to restore a person actually in a state of coma from carbonic acid. This treatment, of course, is subsequent to instant removal from the impure atmosphere. Pure oxygen should also be administered if at hand.

D. Ferrier.

CARBONIC OXIDE, Poisoning by.—Carbonic oxide is a much more dangerous agent than carbonic acid, and to it are due many of the effects sometimes ascribed to the latter. Pure carbonic oxide is rarely generated out of the chemical laboratory, but mixed with other gases carbonic oxide is not uncommon. This is especially the case in the fumes of burning charcoal. The carbonic acid of the burning charcoal while passing over the heated embers loses an atom of oxygen, or takes up an atom of carbon, and is converted into carbonic oxide, which burns with a bluish flame at the top. The toxic action of charcoal vapours is essentially dependent on the carbonic oxide they contain. Usually charcoal fumes contain from 2 to 3 per cent. of carbonic oxide, to 25 of carbonic acid, along with some heavy carburetted hydrogen. The vapours, however, are still as effective after being passed through lime-water, which fixes the carbonic acid. Poisoning by charcoal vapour is not an uncommon form of suicide, more particularly abroad; and many cases have occurred accidentally in this country, from sleeping in rooms in which there was no flue for the escape of the fumes of burning charcoal, or into which there has been leakage from stove pipes, &c.

Carbonic oxide also exists in coal gas, and constitutes its main danger. It is likewise found in the emanations from brick-kilns.

Carbonic oxide is an extremely active poison. Letheby found that ·5 per cent. of carbonic oxide in the respiratory medium killed small birds in three minutes, and that 2 per cent. killed a guinea-pig in two minutes. Many similar experiments have been performed with similar results. The animals soon become insensible, and die generally without exhibiting convulsive phenomena beyond a few tremors or flutterings.

Symptoms.—In man inhalation of carbonic oxide for a short time, as Sir H. Davy and others have proved on themselves, causes headache, pulsation in the temples, giddiness, nausea, and great prostration, tending to drowsiness and insensibility, death being preceded by a state of complete coma. Usually death occurs quietly, but signs of vomiting are frequently observed near those who have been poisoned by charcoal fumes.

Post-mortem Appearances.—The specially characteristic appearance of death from carbonic oxide is the cherry-red colour of the blood and internal organs. The post-mortem hypostasis exhibits a similar bright red tint. Frequently in those poisoned with carbonic oxide the face retains a ruddy hue. The red tint of the blood is due to the compound which carbonic oxide forms with hæmoglobin. Carbonic oxide displaces the oxygen and forms a very stable compound with the hæmoglobin, not readily broken up, and hence the oxygen-carrying power of the corpuscles is paralysed.

In the spectroscope carbonic oxide blood exhibits two absorption-bands very similar to those of ordinary blood-colouring matter or oxy-hæmoglobin, but a difference in the exact breadth and position of the bands can be made out by means of the microspectroscope when the two are compared together. Carbonic oxide hæmoglobin resists reduction in the usual manner, and here again differs from normal blood-colouring matter. Hoppe-Seyler gives as an additional test the action of caustic alkalies on carbonic oxide, and on ordinary hæmoglobin. With the latter it causes a green colour when mixed with it on a porcelain plate, while in the former the colour continues red.

Pathology. — Carbonic oxide acts in the manner indicated, viz., by paralysing the blood-corpuscles, as Bernard expresses it, and rendering them unable to take up oxygen. Hence internal respiration is prevented, and death ensues from asphyxia.

Treatment.—As carbonic oxide hæmoglobin is a very stable compound, and offers considerable resistance to displacement by oxygen, though not absolute as was at one time considered artificial respiration is not likely to be successful by itself. The best treatment is venesection and transfusion of fresh blood. This method of treatment has proved successful in one or two instances in which it has been employed.

D. Ferrier.

CARBUNCLE. — Synon.: Anthrax; Fr. *Anthrax*; Ger. *Karbunkel.*

Definition.—A specific local inflammation of the subcutaneous areolar tissue, rapidly leading to sloughing of the deeper and more central parts, followed by destruction of the skin; the whole of the dead tissues finally separating in the form of a slough.

Ætiology. — Carbuncle is a constitutional affection, dependent upon conditions of general debility or plethora, and often associated with gouty or diabetic tendencies. It is more commonly seen in men than in women; is rarely met with under the age of twenty; and attacks all ranks of life.

Symptoms. — The most usual seat of carbuncle is the back of the trunk or neck, but it may occasionally be found in other situations. The affection usually begins as a painful, hard, slightly elevated, and ill-defined swelling, which gradually increases in extent and assumes a dusky red tint. A vesicle containing bloody serum soon forms over the most prominent part, and on rupturing discloses several small apertures in the subjacent skin, which give exit to a glutinous purulent discharge. This sieve-like condition of the undermined integument often persists throughout the course of the disease; occasionally, however, owing to the destruction of the intervening skin, the several apertures merge into a single, large, ragged opening, and thus expose the characteristic ash-grey, slimy slough, which separates slowly by suppuration, leaving an irregular cavity with deeply undermined edges. The cicatrix left after healing is usually uneven and may be permanently discoloured.

In the early stage of the disease, while the inflammatory œdema is still extending, the patient generally complains of a burning, throbbing sensation in the part, which may become intensely painful; but on the full exposure of the slough, the pain diminishes, and in the later stages it may cease entirely.

When the carbuncle is large, or involves a portion of the scalp, there is usually considerable constitutional disturbance of an asthenic type. Death may then occur from exhaustion, which is sometimes aggravated by free hæmorrhage resulting from incisions; but the most frequent cause of a fatal termination is pyæmia.

Diagnosis.—Carbuncle is distinguished from boil by the size and extent of the swelling, and by its tendency to spread; by the livid tint of the skin, and the early formation in it of more than one aperture; by the character of the slough, by the severity of the pain, and the marked constitutional disturbance; and finally, by the fact that carbuncle, unlike boil, usually occurs singly.

Prognosis.—This will depend chiefly upon the age of the patient, and upon the seat and extent of the disease, which proves most dangerous to life when situated or encroaching on the scalp, especially in a person over fifty. The coexistence of albuminuria or chronic saccharine diabetes is always a grave complication.

Treatment. — The *constitutional* treatment and the management of patients with carbuncle are best conducted on general principles. In ordinary cases the diet should be of good quality and sufficient in quantity, with a moderate allowance of stimulants, proportionate to previous habits. Should the patient's strength and the situation of the carbuncle allow him to move about, he need not be confined to his room, and may even be allowed exercise in the open air.

In the more severe forms of the disease, the frequent administration of dietetic stimulants and good nourishment in an easily assimilable form is usually necessary. The bowels, if they require it, should be cleared out by some non-irritating aperient, and the patient put on a course of quinine or bark and the mineral acids. Opium may be required in the earlier stages to relieve the intense sufferings of some patients;

while in the after-course of the disease, it may be sometimes needed to procure sleep.

For *local* treatment *see* BOILS.

For *carbuncle of the face*, an affection distinct from the Malignant Pustule described by Continental surgeons, *see* PUSTULE, MALIGNANT, and the article on BOILS. WILLIAM A. MEREDITH.

CARCINOMA. *See* CANCER.

CARDIAC DISEASES. *See* HEART, Diseases of.

CARDIALGIA (*κάρδια*, the heart, and *ἄλγος*, pain).—A synonym for heartburn, originating in a popular impression that this painful sensation, which is situated in the epigastrium, is connected with the heart. *See* HEARTBURN.

CARDIOGRAPH, The (*κάρδια*, the heart, and *γράφω*, I write). This is an instrument for registering graphically the form of the heart's movements. We owe the invention of the cardiograph to Marey, who in his physiological researches on the circulation of the blood, obtained by the following means the form of movement of each cavity of the heart. He introduced into the auricles and ventricles of a horse, hollow sounds terminating in elastic ampullæ filled with air. The air communicated through the sounds and elastic tubes with terminal ampullæ, or tympana covered with elastic membrane, on each of which rested a light lever. The movements communicated by the heart to the closed column of air were amplified by the levers and recorded by them on a revolving cylinder. In this way tracings of the forms of movement of each cavity, as well as of the exposed apex-beat itself, were obtained, and an explanation of the several parts of the complex apex-tracing rendered possible. The cardiograph used for clinical research is a modification of the above, and consists of a hollow cup containing a small spring which can be depressed by means of a screw so as to rest firmly on the chest-wall where the impulse is felt. The cup communicates by means of an elastic tube with a tympanum covered with elastic membrane carrying on its surface a lever. When applied to the chest the cup hermetically seals the air column which transmits as waves the motion received by the spring to the lever resting on the tympanum. These movements are recorded by the end of the lever either on the plate of a sphygmograph or on a revolving cylinder.

By means of this apparatus a very perfect representation of the cardiac movement can be obtained, the auricular and ventricular elements traced, and the duration of each measured. The transmission of the motion through an elastic medium like air has been objected to, as liable to modify the tracing by (1) the production of secondary oscillations in the air column; and by (2) gradual change in the form of motion caused by the elasticity of the medium. Practically, however, these objections are not valid, as is shown by the fact that the last of a series of cardiac pulsations is often an exact reproduction of the first, and also by the close resemblance between the tracings obtained in this way and those registered by the sphygmograph, or a modification of it, applied over the apex-beat. A cardiogram collected by the instrument described on a healthy person is given in the margin. Two cardiac revolutions are recorded. The several waves may be interpreted as follows: the wave *a*, in the line of ascent, corresponds with the early part of the ventricular diastole. The wave *b* corresponds with the true auricular systole; from *b* to *d* the line marks the true impulse caused by the ventricular contraction, the rounding of the heart, and its pressure against the chest-wall. The wave *c*, at the summit of the curve, indicates the closure of the auriculo-ventricular valves; *c* does not always form the summit of the curve, but occasionally in slower cardiac contractions forms a wave below the summit. The waves between *c* and *d* are referred to oscillations produced by the closure of the auriculo-ventricular valves, but are probably manufactured by the instrument. The break in the line of descent at *e*, marks the closure of the sigmoid valves. In the above cardiogram the period of ventricular contraction is measured by the space between the commencement of the line of ascent after the wave *b*, to the point *d*, which marks the termination of the systole. When the heart is hypertrophied and acting vigorously this termination is often registered as a slight elevation of the trace.

FIG. 4.

The clinical value of the cardiograph has yet to be fully established. It has hitherto been useful in showing the relation of præsystolic murmur and thrill to the ventricular and auricular contractions; in demonstrating modifications of the form of impulse in adherent pericardium; in recording a considerable increase in the wave *a* and a sudden rising of the trace after *a*, as signs of aortic insufficiency; and in the recognition of the relation between reduplication of the heart-sounds and respiratory influences. The cardiograph is also of great value in registering the form of movement of pulsating tumours and aneurisms. In its application it is sufficient to hold the instrument firmly over the apex-beat and to record the pulsations at the end of expiration, the breath being stopped for a brief interval. Occasionally, when the influence of respiration is to be observed, this precaution is of course unnecessary; but it must be borne in mind that the movement of the chest-wall modifies the tracing.

BALTHAZAR FOSTER.

CARDITIS (*κάρδια*, the heart). Inflammation of the substance of the heart. *See* HEART, Inflammation of.

CARIES (*caries*, rottenness).—A destructive inflammatory disease of bone, analogous to ulceration of soft tissues. *See* BONE, SKULL, and SPINAL COLUMN, Diseases of.

CARLSBAD, in Bohemia. Thermal alkaline sulphated waters. *See* MINERAL WATERS.

CARMINATIVES (*carmino*, I card, or cleanse).

DEFINITION.—Substances that aid the expulsion of flatus from the stomach and intestines, and relieve griping.

ENUMERATION.—The principal carminative remedies are—the Essential Aromatic Oils; Chloroform; Charcoal; Ethers; and Camphors; and substances containing them.

USES.—The uses of carminatives are sufficiently indicated in the preceding definition. They are extensively administered in cases of flatulent dyspepsia, especially when it is associated either with disease or disorder of the heart or with a nervous or hysterical state of the system. A combination of several different carminatives is usually more successful than the exhibition of a single drug. With antacids they are useful in correcting acidity; and they are frequently prescribed with purgatives to prevent pain.

CARNIFICATION (*caro*, flesh, and *fio*, I become).—A condition of the lung in which its tissue resembles flesh. The term was formerly applied to the transformation of any tissue into a flesh-like substance. *See* LUNG, Collapse of.

CARPHOLEGY
CARPHOLOGY } (*κάρφος*, chaff, and *λέγω*, I collect). The movements of the hands and fingers observed in delirious patients, as if they were searching for or gathering imaginary objects. A familiar illustration of the act is 'picking of the bedclothes.'

CARTILAGE, Diseases of.—For a due appreciation of the abnormal conditions to which cartilage is subject, a brief description of this tissue in its healthy state is necessary.

The *temporary* cartilage which forms the early skeleton, gradually undergoes conversion into bone, leaving at the joint surfaces a thin layer, the *articular* cartilage, which never becomes ossified, Certain other portions of the skeleton also retain their cartilaginous condition throughout life; these are known as the *permanent* cartilages, and as examples the cartilages of the ribs, ears, and nose may be given. The extremities of the long bones, or *epiphyses*, remain separate from the shaft for a varying period after birth, and so long as the bone continues to grow, they are attached to it by a thin but important layer of cartilage, called the *epiphysial* cartilage. There are yet the *fibro-cartilages*, in which the fibrous and cartilaginous elements are found in varying proportions, according as the tenacity of the one or the elasticity of the other material is required.

Cartilage is altogether destitute of nerves, and therefore of sensibility; and it is equally devoid of blood-vessels, being nourished by imbibition from the vessels of the neighbouring parts. All cartilages, except the articular and the fibro-cartilages, are covered by a fibrous membrane, the *perichondrium*, which is similar to, and subserves the same purpose as the periosteum. When cartilage has been destroyed it may be replaced by fibrous tissue, or by bone, but it is never reproduced.

Under the microscope a section of cartilage presents a transparent, structureless matrix, studded with nucleated cells; these cells are flattened and arranged parallel with the free surface of the cartilage, whilst more deeply they are elongated and grouped vertically. The nutrient materials are absorbed from the neighbouring blood-vessels, and transmitted throughout the cartilage by means of these cells. In those cartilages where tenacity or flexibility are needed, this hyaline substance is denser and more distinctly fibrillated than in the others.

SUMMARY OF DISEASES.—Cartilage being non-vascular, its inflammation is of a modified type, but it may undergo degenerative changes as a result of impaired nutrition. In uncomplicated disease of cartilage there is no inflammatory exudation, and when lymph or pus is found in a joint, it is obvious that other structures have become inflamed.

1. The ensiform and costal cartilages, with those of the trachea and larynx, show a great tendency to *ossification*, as the result of morbid change or senile decay; they are also liable to *necrosis*. The articular cartilages never ossify, but large portions of them may perish and be detached, in consequence of some interference with their supply of nutriment.

2. The cartilages of the epiglottis, ears, nose, eyelids, and eustachian tube have little disposition to ossify, but they are liable to *ulceration*, especially of the syphilitic variety; in these cases the diseased action commences in the skin or mucous membrane, and spreads to the cartilage by contiguity.

3. The cartilage of the external ear is often the seat of *chalk-stones* in gouty persons, and similar deposits may also be found in the articular cartilages.

4. The epiphysial cartilage may take on an ulcerative action, which leads to separation of the shaft from the epiphysis, a condition which, whether the result of disease or accident, is of great moment, inasmuch as the destruction of this layer of cartilage checks further growth at the end of the bone.

5. Cartilage is not primarily attacked by *cancer*, but it may become involved by the spread of a malignant tumour. The *epithelial* form of cancer not infrequently extends from the mucous or cutaneous surface, in which it originated, to the subjacent cartilage.

6. The articular cartilages are liable to certain structural changes as the result of disturbed nutrition; and the fibro-cartilages are also subject to the same abnormal conditions.

Ulceration, absorption, degeneration of cartilage are terms used to denote a series of destructive changes which take place in the substance of articular cartilage, and lead to its partial or complete removal. These changes may originate in the cartilage itself, or they may be secondary to disease of the bone or synovial membrane: however this may be, the morbid action is the same, and consists in increased cell-development, with disintegration of the hyaline substance.

According to the observations of Goodsir and Redfern, the cartilage-cells become enlarged, filled with nucleated corpuscles, and arranged irregularly; the distended cells then burst, and set free their contents upon the surface of or amongst the altered hyaline substance. Whilst the cell-changes are taking place, the matrix softens: in acute cases it rapidly disintegrates and is discharged; but when the disease is more chronic, it splits up

into fibres which remain attached by one end to the cartilage, and by the other project loosely into the interior of the joint, giving a villous appearance to the affected spot. The remains of the matrix, and the granular contents of the cells together form a fibro-nucleated membrane, which ultimately is converted into fibrous tissue, and constitutes the sole medium of repair when a cure is effected. When this membrane is recent it has an indistinct granular appearance, from the presence of nuclei amongst the fibres, and according to Rainey these nuclei are often converted into fat-globules; when the membrane is of older date it is distinctly fibrous; and no doubt the several appearances which the membrane presents under different circumstances has led to the several terms *fibrous*, *fatty*, and *granular degeneration* being applied to this disease, in the belief that they were really distinct pathological conditions.

Ulceration generally commences upon the free surface of the cartilage, but it may begin at any part. It is usually superficial, but sometimes extends completely through the substance of the cartilage, exposing the bone: commonly limited in extent, it occasionally spreads over the whole surface; it is ordinarily confined to a single joint, but more than one may be affected. As a rule the disease progresses slowly, but it may run its course more rapidly. *See* JOINTS, Diseases of.

7. *Hypertrophy* of the articular cartilages has been described, but, as in these cases the cartilage was found swollen and soft, it is probable that they were examples of commencing disease, rather than of actual increase of texture.

8. *Atrophy* has been observed as the result of pressure, and of the natural wasting which occurs in advanced life; it is also said to be occasionally produced in younger subjects by disease.

GEO. G. GASCOYEN.

CASEOUS DEGENERATION.—A form of degeneration in which the products have the appearance of cheese. *See* DEGENERATIONS.

CASTS. (*Kast*—Swedish and Danish—a throw.)

DEFINITION.—A term applied to moulds of gland-tubules and hollow viscera, thrown off in certain states of disease.

CLASSIFICATION.—The varieties of casts met with may be represented according to the following arrangement:—

A.—CASTS OF GLAND-TUBULES.

I. **Of the Uriniferous Tubules.**
- Blood-Casts.
- Pus-Casts.
- Hyaline Casts.
- Granular Casts.
- Epithelial Casts.
- Fatty Casts.

II. **Of the Seminal Tubules.**
III. **Of the Gastric Tubules.**
IV. **Of the Cutaneous Glands.**

B.—CASTS OF HOLLOW VISCERA AND PASSAGES.

I. **Of the Alimentary Canal.**
II. **Of the Urinary Bladder.**
III. **Of the Female Genital Passages.**
IV. **Of the Respiratory Passages.**

A.—CASTS OF GLAND-TUBULES.

I. **Of the Uriniferous Tubules.**—Dr. F. Simon of Berlin is usually credited with having been the first to describe these bodies in his work on *Medical Chemistry*, published in 1842; but it appears that before then they had been noticed and described by Vogla in 1837 and 1838, by Rayer in 1838, and by Nasse of Marburg in 1842. These observers, however, do not seem to have entered on the question of the origin, structure, or significance of these bodies, and for years they were looked upon rather as curiosities, and by some writers, notably Glup, were wholly disregarded. Heller, in 1845, appears to have been the first to refer their origin to the coagulable matter of the blood, but it was some time after that date before their value in the diagnosis and prognosis of renal diseases came to be appreciated. This result has been mainly effected in this country by the labours of Basham, Beale, Johnson, W. Roberts, Dickinson, and Grainger Stewart.

Casts may be formed in any part of the kidney. They have been found in the convoluted tubules even up to the Malpighian capsules, and also in the straight tubules. Not infrequently small casts formed towards the terminations of the tubules come to be enclosed in their passage onwards within casts of the larger ones.

CHARACTERS.—The urinary casts are mostly cylindrical in shape, frequently somewhat coiled and bent, and occasionally forked. Their length, depending very much on accidental circumstances, varies considerably. In sections of the kidney they may be traced occasionally for some distance in the tubules, becoming broken up into smaller pieces after leaving the kidney. In diameter the casts range between 1·1000th and 1·500th of an inch—the former being known as 'small,' the latter as 'large' casts. The greater number are of a 'medium' size of 1·700th of an inch. The diameter of the casts is in part determined by the calibre of the tubule in which they are first formed, and in part by any subsequent additions they may receive in their passage outwards. Dr. Beale has suggested that after their formation the casts may probably shrink. In tubules that have become abnormally dilated or contracted, casts beyond the limits above mentioned may be found.

The appearance of renal casts varies considerably, not only in different kidney-diseases, but also in various stages of the same affection. In all cases the cast consists of a solid cylinder of a transparent or a very faintly granular substance, which in certain cases is fibrillated. What the nature of this base-substance is is still uncertain, and it appears probable that its composition is not constant in the different varieties of casts. It was formerly accepted that these bodies were produced by a coagulation of fibrin due to an escape of blood-plasma into the tubules, and hence they were known as 'exudation-cylinders'—a term still often employed. It is easy to understand the formation of casts in this manner, and it is certain that such *blood-casts* do occur, whether as shreds of fibrin with abundance of blood-corpuscles in its meshes, or as casts con-

sisting of little more than pure fibrin with its characteristic fibrillated appearance. In a similar manner *pus-casts*, so called, may be produced.

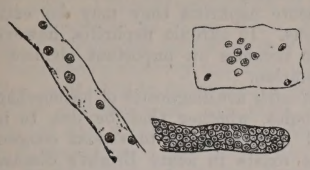


FIG. 5.—Blood Casts.

In those forms of renal disease, however, in which casts are found in the urine, when no hæmorrhage into the kidney tubes exists, one of the commonest appearances of these bodies is that of a transparent and faintly granular, tolerably uniform cylinder, frequently somewhat rounded at the extremities, and often overlooked

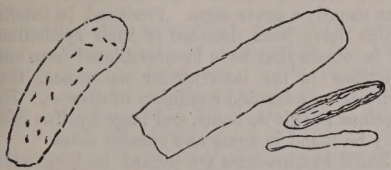


FIG. 6.—Hyaline Casts.

unless searched for with care. In them no sign of fibrillation is to be discerned, and they do not correspond in their chemical behaviour to fibrin. These are the *hyaline, transparent,* or *waxy* casts, which may be large, small, or medium in diameter. What the substance is of which they are composed is uncertain. It is distinctly not fibrin, nor is it inspissated albumin, as has been suggested. In many cases a considerable proportion of mucin has been obtained from them. Though frequently called 'waxy,' and often occurring in the urine from a waxy and amyloid kidney, it is extremely doubtful if they ever consist of the amyloid matter which is produced in the lardaceous degeneration of that organ.

According to the writer's view this cast is the result of a colloid degeneration of the renal epithelial cells, comparable to what is met with in other protoplasmic tissues. In consequence of this change in the cells they lose their normal appearance, and form into homogeneous, transparent masses, occupying the now denuded renal tubules, from which they are subsequently washed out by the urine secreted behind them. Other observers have regarded them as being formed of a substance secreted by the renal epithelial cells, rather than an actual conversion of the cells themselves. And Dr. Beale has 'thought it not improbable that these casts of the uriniferous tubes may really be composed of the material which in health forms the substance of epithelial cells. In disease this substance, perhaps somewhat altered or not perfectly formed, collects in the tubes and becomes inspissated.' Whatever may be the true explanation of their formation, they present themselves as semi-solid and somewhat viscid cylinders, readily entangling adjacent matter. Due to this property is much of the variety they offer; thus, should the epithelium of the tubules be loosened, from

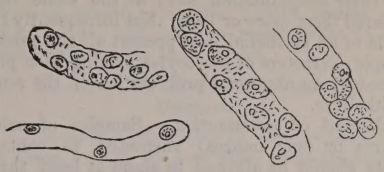


FIG. 7.—Epithelial Casts.

any cause, the cells will cohere to the cast which has been formed in the lumen of the tube, and an *epithelial cast* will be voided. Should the cells have undergone fatty degeneration the cast will be pervaded with oil-globules of all sizes, more or less escaped from epithelial cells, accord-

FIG. 8.—Fatty Casts.

ing to the extent of the degeneration; this constitutes a *fatty cast*. Very frequently the casts are finely or coarsely *granular*, this appearance being produced by the involvement in

FIG. 9.—Granular Casts.

the base-substance of the cast of granular matter derived from broken-down epithelial cells or blood-corpuscles, molecular fatty matter, or very frequently amorphous urinary salts. In a similar way casts may be found containing *crystals*

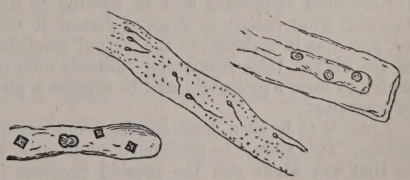


FIG. 10.—Casts enclosing crystals; and a smaller cast; also of seminal tubule with spermatozoa.

of oxalates, triple phosphates, &c. Very slight proof exists of any of the numerous theories that have been offered to explain their formation.

It is very commonly the case that more than one variety of cast occurs in the same urine, epithelial and hyaline, or granular and fatty, often co-existing. Corresponding to the casts in the urine, free epithelial cells, blood corpuscles, fat globules, and salts, amorphous or crystalline, are

always found. The epithelial cells, whether free or on the cast, are rarely quite normal in appearance. The pathological changes which have led to their desquamation have at the same time altered them more or less. Not infrequently the cells of an epithelial cast present all the microscopic characters of leucocytes, having been produced by an abnormal proliferation of the renal epithelium.

Method of examination.—Samples of urine (three or four ounces) suspected to contain casts should be allowed to stand at least three hours in perfectly clean conical glasses, and a few drops should be removed from the bottom with a pipette, and covered in the usual way on a glass slide. For all practical purposes a $\frac{1}{4}$-in. objective, giving with the eye-piece a magnifying power of about 350 diameters, is sufficient. The hyaline casts are often so transparent as to escape any but the most careful observation, and then a little magenta or carmine staining fluid, introduced beneath the cover-glass, much facilitates their detection; cutting off some of the light used has a similar effect. As a rule there is no mistaking a renal tube-cast, but occasionally a transparent or granular streak may be noticed, the nature of which cannot be positively stated; shreds of mucus, especially when mixed up with granular matter, are the commonest objects which simulate casts; their disappearance on the application of a little heat to the slide determines their character.

Clinical significance.—Valuable—almost indispensable—as is the evidence afforded by the detection of these bodies in the urine, their recognition and comprehension is nevertheless but one of the means to be employed in the study of renal diseases. Of themselves they afford practical information, rarely, if ever, conclusive when taken alone.

Without doubt certain renal diseases may exist, and may continue throughout their course either to recovery or death, without the occurrence of casts in the urine. But for all practical purposes it may be accepted that when casts do occur, they indicate the existence of a disease of the kidneys which is possibly incurable, certainly serious. Besides the value of casts in determining the existence of kidney-disease, they are further most important aids in helping to distinguish what variety or stage of disease it may be, and also in making out the actual condition of the kidney, thus furnishing valuable data on which to form a prognosis, and to suggest a plan of treatment.

Little is to be seen, however, from one examination. This should be performed frequently, as in that way alone can the morbid progress in the kidney be recognised.

From what has been said of the nature of casts, it should be expected—as is the case—that several varieties of these bodies occur at the same time in the urine. It is rare for any variety to exist singly, at least for any time. In such cases their significance is ascertained by careful study of coincident circumstances, and especially by a frequent comparison, in order to determine which variety is in excess.

The fact that casts are very abundant in any sample of urine is not in itself of necessity a serious sign. Thus in 'granular kidney'—one of the most serious of all renal affections,—the casts may be, and usually are very few, and require careful looking for; whilst in the convalescence from acute nephritis they may be extremely numerous. In chronic nephritis, however, the number becomes an important element in the consideration.

Blood-casts are diagnostic of hæmorrhage into the tubules, whether that be due to intense arterial hyperæmia or to venous congestion—such as exists in acute Bright's disease from whatever cause—resulting in escape of blood from the vessels.

Pus-casts may indicate the bursting of a renal abscess into the tubes, and coagulation of the escaped pus. Very often, however, the leucocytes which take part in the formation of a pus-cast have another origin, viz. from the renal epithelial cells, being the result of their proliferation in the inflamed state.

Hyaline casts.—The large forms of this variety chiefly occur in chronic nephritis, and are therefore usually a grave sign. Produced in tubules which have been denuded of their epithelium, or in others that have become dilated from contractions in the intertubular substance, they indicate an advanced condition of disease. Exceptions to this do occur, and large hyaline casts may be found in acute and curable cases.

Small hyaline casts are formed in both acute and chronic forms of renal disease. They therefore become valuable as means of diagnosis only in conjunction with other signs, such as the history of the case, the character of the other urinary sediments, &c. They are frequently seen in acute nephritis, particularly in the later stages of the disease, and are then formed in tubes which have not been stripped of their epithelial lining. In simple congestion of the kidney they may be formed, from a coagulation of the fibrin of the effused plasma. When associated with the large variety they usually indicate a chronic and advanced stage, being then found in tubules that have become contracted. These two varieties of hyaline casts are common in the albuminoid kidney, and similar casts have been met with in the tubules in cases of diphtheria.

Granular casts.—The significance of these is very variable. As has been said, the granular casts differ much in nature, and no positive diagnosis can be made upon them alone. They may occur in conjunction with blood-casts where the corpuscles have broken down, and they will then generally indicate a commencing recovery from an acute stage. A similar interpretation may sometimes be put on casts whose granulation is due to fat molecules resulting from the degeneration of inflammatory products. Large, dark, and coarsely granular casts are more particularly noticed in 'granular kidney,' where indeed they may be the only casts found. In such circumstances they become a very serious sign. In the later stages of chronic nephritis the epithelial cells disintegrate and produce granular casts.

Epithelial casts.—These are more especially met with in the earlier stages of nephritis, and their significance much depends on the character of the epithelium cells. They may be very abundant at first; later on, when the hyaline variety

appears in the urine, becoming less numerous. The epithelium cells may differ but little from the normal renal epithelium, or they may be fatty and more like leucocytes in appearance.

Fatty casts.—Probably no casts are so general in their occurrence as these. Their presence may be of the gravest import, or they may betoken commencing recovery, and more than any, therefore, must they be considered in connexion with other circumstances. The casts that are found in the later stages of acute nephritis during convalescence are in part fatty. The inflammatory products undergoing this degeneration are those thrown off. Hyaline casts, both large and small, frequently present a few oil-globules on their surface. And in certain forms of chronic nephritis the casts may appear as if made up of oil-globules only. In such case an advanced stage of fatty degeneration of the gland is distinctly indicated, and the persistence of fatty casts is generally taken to signify the same; though such casts have been known to continue in numbers for some weeks, and to be followed by recovery.

Casts in non-albuminous urine.—The existence of renal casts in such urine has been noticed for some time past. If the casts were formed from any of the elements of the blood, their appearance could not be explained; but if, as has been said, these bodies owe their formation to the degeneration of, or of a secretion from, epithelial cells, their occurrence under such circumstances is intelligible. The conclusion that the urine is non-albuminous must not be too readily made; there may be so small an amount as to escape notice with the ordinary rough method of testing, and there may be only a temporary disappearance of the albumin. The casts that are formed in non-albuminous urine are of the hyaline variety.

Those that are frequently found in the urine of persons suffering from icterus from whatever cause, and which are stated by Nothnagel to be in direct proportion to the intensity of the jaundice, are said not to be associated with albumin. The pathology of these casts is not as yet understood.

II. Of the Seminal Tubules.—Dr. Beale has pointed out the occasional existence in urine of casts containing spermatozoa (*see* Fig. 10). The base-substance of their bodies is a viscid tenacious mucus, and they are usually much larger than the casts derived from the uriniferous tubules. They have not been found associated with inflammatory conditions of the testicle, and do not correspond pathologically to the renal casts above described.

III. Of the Gastric Tubules.—In inflammation of the gastric mucous membrane, especially in scarlet fever, a desquamation of the epithelial coat involving the glands has been noticed. The casts of the follicles have been found in the vomit, and more abundantly in the contents of the stomach *post mortem*. Their length is variable, and in width they range from $\frac{1}{600}$th to $\frac{1}{1000}$th of an inch. The base-substance is described as fibrinous, and is covered more or less completely by altered epithelial cells and granular *débris*.

IV. Of the Cutaneous Glands.—In the various skin-affections which are associated with desquamation of the cuticle, casts of varying length, coming from the sweat- and sebaceous glands, are thrown off as part of the general shedding of the epidermis. Such bodies are hollow tubes, and bear no resemblance to the inflammatory casts in nephritis.

B.—Casts of Hollow Viscera and Passages.

From time to time, more or less perfect casts of these organs are met with. The conditions which determine their occurrence are but imperfectly understood; they are in some cases associated with inflammation of the surfaces from which they are thrown off, but in other cases appear to be independent of any such morbid changes.

I. Of the Alimentary Canal.—Inflammation of any part of the canal, from mouth to rectum, has been known to give rise to the detachment of flakes of the superficial epithelium embodied in a very viscid, tenacious mucus. It is in scarlet fever that this condition has been usually seen, where the degeneration of the mucous membrane corresponds to the skin-shedding. Occasionally complete hollow moulds of portions of the intestine are found, and large pieces have been recognised as coming from the stomach (Beale). Similar results may follow croupous and diphtheritic inflammation.

II. Of the Urinary Bladder.—A complete exfoliation of the mucous membrane of the bladder has been occasionally observed in puerperal women. It does not appear to be always the result of inflammation, and though the detachment may be complete, perfect recovery may follow. In structure such bodies consist of epithelial cells in varying stages of degeneration, felted together by mucus and fine granular material. The surface is frequently thickly coated with urinary salts. The conditions giving rise to their formation are quite unknown, though retention of urine is associated with their occurrence.

III. Of the Female Genital Passages.—Casts of the uterus and vagina have been frequently noticed. Occasionally they are thrown off periodically, and may then be accompanied with much pain and hæmorrhage (membranous dysmenorrhœa). Partial casts of the passages have also been found associated with diphtheria. These false membranes may form complete casts of the uterus, leaving only the orifices of the internal os and Fallopian tubes, and appear as shaggy bags, consisting of the epithelial layer of the organ. Sometimes these bodies may be the decidua in an early stage, but they have also been met with in virgins.

IV. Of the Respiratory Passages.—Casts of some portion of the air-tubes are of frequent occurrence, associated with a special form of inflammation, known as croupous or diphtheritic. In such cases the epithelial covering of the mucous membrane comes to be replaced by a layer of material which is derived from the metamorphosed epithelial cells, with a variable amount of coagulated fibrin formed from the effused blood-plasma. Such false membrane appears under the microscope to be made up of interlacing

fibres of a clear homogeneous-looking substance, felted together in all directions, and containing in the meshes leucocytes, altered epithelial cells, blood-corpuscles, and a small quantity of serum. The exact method of formation of such a membrane is still a matter of dispute—how far it depends for its occurrence on blood-fibrin, and how far on a 'croupous metamorphosis' of the original epithelial cells, such as was described in speaking of the formation of hyaline renal casts. The fibrous material of the membrane, however formed, strongly resists the action of ordinary reagents.

It is easy to understand that the extent to which the materials constituting this membrane infiltrate the deeper layers of the mucous membrane, must vary considerably; yet in the extent of infiltration and consequent adherence, very much depends the distinction, such as it is, between croupous and diphtheritic exudation. In the larynx and trachea, the new material forms more or less complete layers, covering the vocal cords, dipping into the ventricles, and even blocking up the laryngeal cavity completely. By the effusion of serum beneath the membrane, it is loosened and may be expectorated in pieces varying in size from mere shreds up to complete casts.

When this inflammatory product originates in the bronchial tubes, it forms the so-called bronchial polypi, so characteristic of Plastic Bronchitis. It is rare for more than very limited areas of the air-passages to be so affected, but within these areas perfect casts of the entire extent from trachea to alveoli may be obtained. Expectorated as irregular, rolled-up, and twisted masses, they are capable of being shaken out in water into ramifying whitish, or pinky white, moulds of the tubes. They are either hollow and membranous or solid, and in the latter case frequently present indications of being made up of concentric layers. Similar casts of the smallest tubes are found in the expectoration of acute croupous pneumonia. It would seem then that the material formed on the surface of the mucous membrane of the air-passages throughout their whole extent, and which may form more or less perfect casts of their passages, is identical in structure, and probably in method of formation, wherever be its situation, whether limited to the larynx and trachea (croup and diphtheria), or only in the terminal air-tubes (acute croupous pneumonia), or throughout the entire length (plastic bronchitis).

W. H. Allchin.

CATALEPSY (*κατάληψις*, a seizure).—Definition.—A disease of the nervous system, characterised by attacks of powerlessness, commonly with loss of consciousness, accompanied by a peculiar form of muscular rigidity, in which the limbs remain for a time in the position in which they are placed.

Ætiology.—Catalepsy may occur at all ages between six and sixty years, and in both sexes, but it is incomparably more frequent in the female sex and in early adult life, at or soon after puberty. It is, in the majority of cases, associated with distinct evidence of hysteria: and in other cases, in which no hysterical symptoms have preceded it, the affection may be traced to such exciting causes as give rise to the hysterical paroxysm. Nervous exhaustion is the common predisponent; and emotional disturbance, especially religious excitement, or sudden alarm, and blows on the head and back, are frequent immediate causes. It occasionally occurs in the course of mental affections, especially melancholia, and as an early symptom of epilepsy. In an imperfect form it has appeared to be due, in some cases, to paludal poisoning or to other toxæmic states, as chloroform-narcosis. In a few cases meningitis, and other organic cerebral or spinal diseases, have caused a cataleptoid condition: but these cases are too rare and diverse to allow of any inference from them.

Symptoms.—In some cases headache, giddiness, or hiccough, has preceded the attack. The onset of the special symptoms is usually sudden, commonly with loss of consciousness. The whole or part of the muscular system passes into a state of rigidity. The limbs remain in the position they occupied at the onset, as if petrified. The muscular rigidity is at first considerable, and movement is resisted; but after a short time the limbs can be moved, and then remain in the position in which they may be placed. The resistance to passive movement is peculiar: it is as if the limbs were made of wax, and hence the condition has been termed *flexibilitas cerea*. The rigidity commonly yields slowly to gravitation. The countenance is usually expressionless. The respiratory movements and heart's action are weakened. Substances placed in the back of the mouth are swallowed, but slowly. The state of sensibility varies; in profound conditions of catalepsy it is lost to touch, pain, and electricity, and no reflex movements can be induced even by touching the conjunctiva. In other cases partial sensibility remains, and reflex phenomena may be excited. In rare instances paroxysmal hyperæsthesia is present. Consciousness is frequently lost, but may remain, rarely intact, more often in an obscured condition. The temperature is commonly lowered. The attack may last a few minutes or several hours. Recovery is gradual or sudden; it is common for the patient at first to be unable to speak. Sometimes a strange periodicity may be observed in the occurrence of the paroxysms. In the intervals between the attacks, headache, giddiness, or hysterical manifestations may be present, or the patient may feel and seem perfectly well.

Pathology.—Concerning the nature of the disease there has been much speculation, but little definite knowledge. It may probably be placed between epilepsy and hysteria in the scale of maladies. There is distinct interference with the intellectual processes, and interruption of the connection between the will and the motor centres. The rigidity has been thought by Rosenthal to be reflex, but the abeyance of other reflex symptoms makes it more probable that, as Holm suggests, it is of central origin.

Diagnosis.—Many cases of simple trance have been included under Catalepsy, but it is better to restrict the name to the condition in which the peculiar rigidity exists. Hysteria with tonic spasm has also been erroneously termed catalepsy. The condition is sometimes simulated:

In true catalepsy the rigid limb slowly yields to the influence of gravitation, and more rapidly if a weight be attached to it; in the feigned form the limb and weight are held firm.

Prognosis.—The prognosis is favourable in simple catalepsy, in proportion to the freedom of the intervals from affections of sensibility or motion. In pronounced hysteria and psychical affections the condition is often obstinate, and, by interfering with the due nourishment of the system, may cause grave inanition.

Treatment.—During the attack itself little can be done save an attempt, which may be repeated at intervals, to rouse consciousness by external stimulation. The ordinary applications, ammonia to the nostrils, cold douches, &c., often fail. A pinch of snuff will, however, often succeed. Another effectual stimulant is Faradisation. It may be applied to a limb or to the cervical spine. The current should be gentle at first, and gradually increased. Emetics are also useful in cutting short an attack. Injections of tartar emetic into the veins have been used with success by Calvi, but can hardly be recommended. Subcutaneous injection of apomorphia, $\frac{1}{20}$th to $\frac{1}{12}$th of a grain, the writer has found an efficient remedy for similar paroxysmal conditions; with the onset of nausea, about five minutes after the injection, consciousness is regained, and all spasm ceases. In the intervals between the attacks the treatment is that of hysteria. Iron, antispasmodics, especially valerian, alvetic aperients, and cold baths, are the most effectual measures. Firm moral treatment is also indispensable. Removal from home influences is often necessary to effect a cure. W. R. Gowers.

CATAMENIA, Disorders of. *See* Menstruation, Disorders of.

CATAPLASM (κατὰ, down, and πλάσσω, I mould or smear).—A synonym for a poultice. *See* Poultice.

CATARACT (καταράκτης, a waterfall).—Definition.—Cataract is an opacity of the lens—the want of transparency being sufficient to prevent, at least in that part of the lens which is opaque and to the extent of the opacity, the discrimination, with the ophthalmoscopic mirror, of the details of the fundus of the eye.

Ætiology and Pathology.—Cataract is produced in various ways. Any change in the normal relationship of the lens-fibres may cause such a degree of opacity of the lens as is understood by the term cataractous. This is usually a senile change, and it is then a sclerosis of the lens. The question of the normal nutrition of the lens is yet unanswered. If there be a solution of continuity of the capsule of the lens, so that the aqueous humour has access to the lens proper, unless it be in cases of minute punctures and small, clean-cut wounds, which soon heal and scar, the whole lens becomes swollen by endosmosis, grey, and cataractous. A symmetrical change in the lenses, somewhat similar in appearance, is observed in some cases of diabetes, and is occasionally seen in albuminuria. The lens may be found to be ill-developed and cataractous at birth; while others, apparently as a consequence of ill-development, but not during the whole period of growth of the lens, are partly cataractous and partly transparent, and show opaque concentric lamellæ. Besides this instance showing the anatomical configuration of the lens, cataracts not unfrequently demonstrate its normal trifid division as transparent lines; and the striæ of striated cataracts are always in directions radiating to or from the centre of the lens, in the course of the fibres.

Besides these scleroses, endosmoses, and imperfections of the lens proper, there are many opacities appertaining to this part of the refractive apparatus, which were formerly, and are still commonly called cataract. Among these there are the *capsular cataracts*, which do not imply any real opacity of the capsule of the lens, but only an opacity of that part of the lens which is next to the capsule—the rest remaining transparent—or the deposit of some opaque matter upon the lens-capsule externally. *Pyramidal cataract* is formed by the deposit on the anterior surface of the front of the lens-capsule, at or near its centre, of a patch of lymph, when an ulcer has formed in the cornea, and perforation has occurred, by which the aqueous humour is evacuated, the anterior chamber obliterated, and the lens approximated to the cornea, if it is not brought into actual contact with it. When the aqueous humour is again retained, the mass of lymph is drawn out into the pyramidal form, and if, in any case of pyramidal cataract, there has been no perforating ulcer to evacuate the aqueous humour, it must be remembered that these so-called cataracts only occur in early life, when the anterior chamber is very shallow. There is a large class of cataracts called *secondary*, where the condition is due to an earlier disease of the eye, and in which the latter is of course in the first place to be considered. Such cases are the *glaucomatous*, in which, when excessive intraocular pressure has existed some time, the lens, no doubt by interference with its due nutrition, becomes cataractous; and iridectomy for glaucoma is chiefly indicated, whether or not the lens should require to be extracted subsequently. Other secondary cataracts are those called *posterior-polar*, in which the opacity begins at the centre of the back of the lens and is preceded by some deep-seated disease of the fundus of the eye, which is of greater and certainly of prior importance.

Symptoms.—A patient, having uncomplicated cataract, complains of his vision, if he complains at all, for a small definite opacity is easily disregarded, even if it be in or near the centre of the lens or of the axis of vision. If it occupies a considerable portion of the pupillary area, it can of course be no longer considered small, or be disregarded by the patient. If the cataractous opacity begins in the circumferential parts of the lens, and only there, it may, on the contrary, make very considerable progress before it is found out by the patient. In the majority of the various cases of cataract, the patient sees better with his pupils dilated—he prefers to sit with his back to the light, he holds his hand over his eyes, or he holds his head down and frowns in order to see better—he is cheerful, and is always trying to see. In such cases as these quacks have made profit of the benefit the patient has

derived from each visit, when a drop of belladonna or atropine solution has been used for the 'cure' of the malady.

The only complication or ill result of the existence of non-traumatic cataract as such, is in the congenital forms, in which for want of use the retina suffers and nystagmus follows. It is therefore imperative that cataract in infancy should be operated on at an early age.

Diagnosis.—The diagnosis of cataract is, in most cases, easy enough. The position and shape of the crystalline lens being known, an opaque body is seen to exist in its place, or in a part of it. The cataractous opacity varies from milky to chalky white; striæ in it often appear glistening, like newly-dissected tendon; some cataracts are amber-coloured. A drop of liquor atropiæ sulphatis should be used to dilate the pupil; and, this being effected, the opacity behind it cannot be one of the results of a past iritis, which would not leave the pupil free to dilate fully and circularly. The ophthalmoscope should then be used, not only for the diagnosis of a cataract, but also for ascertaining the degree of opacity, and, if not too late, the state of the fundus; and for determining thus the probable future need and success of an operation for its removal. If, notwithstanding an evident opacity in the situation of the lens, otherwise seen, all the details of the fundus viewed with the ophthalmoscope are unobstructedly discernible, it is not a case of true cataract. Senile lenses have, as a rule, an evident diffused opacity which does not imply any beginning of cataract formation. There are generally striæ in the cataractous lens, which converge to the centre from the circumference, or diverge from the centre to the circumference, and if the fundus can be illuminated with the ophthalmoscopic mirror, the opaque parts of the lens appear dark, the reflected light coming from behind them; but, on the other hand, if the ophthalmoscopic convex lens be used to concentrate the lamp-light obliquely on the cataract, the opaque parts appear light, as they reflect the light, and are backed by the fundus which is not thus lit up. Striæ on the posterior surface of the lens are seen to be concave; and, in senile cases, being viewed through a lens having the natural yellow tint of senile lenses, they also appear yellowish. Some cataracts begin as a haziness, chiefly in the centre, the so-called *nucleus*, which is always increasing; and, seen by oblique illumination, there is in these cases, on the side of the light, a shadow of the iris cast on the light-reflecting opacity, and the lens-opacity seems to be most on the side furthest from the light, whichever that may be.

Prognosis.—The prognosis of cataract, in a medical sense, is bad. It is very doubtful if it ever can be at all arrested in its progress, not to say cured or even lessened. In all probability the cataractous opacity is scarcely ever diminished—on the other hand it does not always progress. Very many old persons have cataractous striæ in the marginal part of their lenses, which are of no inconvenience to them, and are only by chance discovered by the surgeon. If the striæ should invade the pupillary area, vision, in one eye at least, will be very likely still sufficient for the requirements of the patient, and the interference of the surgeon will never be called for. As to the prospects of success in operating—uncomplicated cataract, of course, never leads to absolute blindness—the patient sees and evidently observes the light and light-reflecting objects; the field of vision is perfect; the pupil is active; the general health is good; the cataractous opacity is not of the posterior-polar variety, and there are no other complications; all parts of the lens are more or less opaque. Immature cataracts must not be extracted unless neither eye is good for vision, and the progress towards maturity is exceedingly tedious, because the transparent parts of the lens, unseen, are likely to be left behind in the operation, and then to set up inflammation. The dangers from cataract operations are less in childhood than in older persons. In early life any subsequent inflammation threatening the eye can be averted by timely interference with a certainty of success, and an operation should therefore be recommended, although the cataract only affects one eye. In old age if one eye be available for vision, an operation for mature cataract in the other eye is not to be performed unless the patient himself desires it.

Treatment.—Cataracts have seldom, the writer believes, any practical bearing as regards medical treatment. In cases of diabetes and of temporary albuminuria, in which a cataractous condition occurred, the state of the lens has been found to improve with the general health of the patient. In a patient with diabetic cataracts appropriate treatment may remove the opacity of the lenses and restore vision; and the writer has seen senile cataract advance rapidly when the patient has been in any way lowered in general health, and then again advance slowly as before when the health has been restored.

Besides the palliative treatment by atropine drops constantly used (if vision be improved by their use), the capital surgical treatment is the only one available for cataract—the opaque lenses must be removed, and spectacles of different powers must be worn as substitutes for the natural lenses and power of accommodation. Exception must be made in the case of some lamellar cataracts, with a wide transparent margin, in which an iridectomy is sufficient for the restoration of vision. In infancy and youth the best proceeding is the needle-operation, by which, with a fine needle only, entered through the cornea, the anterior capsule of the lens, and the lens itself also to some extent, are broken up, and, by repetitions of the same operation, the whole is exposed to the action of the aqueous humour and thus gradually absorbed, the posterior lens-capsule being left as a barrier to the vitreous humour behind it. It is very safe when atropine drops are constantly used, and the case is continually watched, so that, if too sudden or too great a swelling of lens-matter should at any time occur by the admission of the aqueous humour, and there be a threatening of iritis as a consequence of mechanical pressure on the iris, the swollen lens-matter may be at once evacuated by the introduction of a broad needle through the cornea, and then of a grooved curette or suction-syringe, by which the semifluid mass, or a sufficient quantity of it, may be got rid of. In old age, and

generally in adult life, the cataractous lens to be removed should undoubtedly be extracted as a whole and at one time. The needle operations, which in young persons are not completed in any case in less than a few weeks or months, take a longer time to complete in proportion to the age of the patient; in adults the process is much slower, and in old age it would be indefinitely prolonged; more important still, the eyes by age become less and less tolerant of what may be called a foreign body, and more liable to iritis, while the iritis is less easily subdued. Then again the central part or nucleus of the lens especially grows harder as the patient becomes older; and if the patient be too old for the safe adoption of the minor operation, this so-called nucleus would become a much more likely source of irritation, particularly if it floated freely in the aqueous humour, than the swollen soft lens-matter of the juvenile lens when thus operated upon. The so-called hard cataracts of old age must, without doubt, be extracted. A section with a knife is made, of somewhat less than half of the corneal circumference; then, as is usually practised now-a-days, that part of the iris lying beneath the corneal section is excised, for the easier and more safe extrusion of the hard lens; the anterior capsule of the lens is freely lacerated; and, by pressure in the ciliary region opposite to the opening made, the lens is gradually forced out of its capsule and out of the eye, including subsequently all the softer circumferential cortical parts of the cataractous lens. The edges of the corneal wound being rightly in apposition, the eyelids are closed, and both eyes are firmly but lightly bandaged for some days, until at least the corneal wound is healed, so that the aqueous humour is again retained. The cataracts of adults, though they may not be old people, in most cases should also be extracted. But at this age cataracts are not common, except traumatic cataracts, and these, and many other varieties, cannot be briefly described in a general way.

J. F. Streatfeild.

CATARRH (κατὰ, down, and ῥέω, I flow). Synon.: Coryza; *Catarrhus* (Cullen); *Catarrhus Communis* (Good); *Rheuma*; Fr. *Catarrhe, Coryza*; Ger. *Katarrh, Schnupfen.*

Definition. — The term catarrh is applied generally to inflammations of the mucous membranes attended with increased secretion. Thus authors speak of *catarrh of the stomach, intestines, bladder, &c.* In the present article the term is limited to the inflammatory affections of the upper part of the air-passages, resulting from cold, and attended by discharge from the nostrils, soreness of the throat, hoarseness, and cough. The term coryza is, however, more especially limited to the cases in which there is copious discharge from the nasal passages, while catarrh is applied to affections of the whole mucous membrane, including the fauces and larynx.

Symptoms.—The attack generally commences, shortly after exposure to cold or more particularly to cold and damp, with a feeling of indisposition, sense of cold down the back or general chilliness, weight in the forehead, headache, especially frontal, and dryness of the nares and throat. These symptoms are succeeded by the discharge from the nostrils of a thin acrid fluid, watering of the eyes, pains in the face, soreness of the throat and hoarseness, with aching in all parts of the body, and disinclination to bodily and mental exertion.

At first the affection is often confined to one nostril, and there is pain in the corresponding temple, eyebrow, eyeball, and side of the face, and lachrymation on that side, but it soon appears in the other nostril, and involves both eyes and all parts of the face; and there is great sense of weight and pain in the forehead and eye-brows. The discharge, also, loses the thin character and becomes mucous, and is often very profuse; there is copious lachrymation, the throat becomes decidedly sore, the hoarseness is greater, and there is pain in speaking and sometimes almost entire loss of voice. There are also transient pains in the chest, with a sense of tightness and some wheezing. The appetite from the first is impaired, and there may be entire distaste for food, and sometimes sickness and vomiting; not unfrequently there is some sense of weight in the right hypochondrium, and sallowness of the complexion; the bowels are usually confined, but there may be diarrhœa. The tongue is generally white, the pulse may be a little quickened, the skin may be dry, the temperature is raised, and the urine is scanty and somewhat high-coloured and deposits a little sediment. The pains in the head and face especially affect the forehead, the eyebrows, the root of the nose, the eye-balls, and the course of the dental and other nerves; they generally increase towards night, and may be so severe as entirely to prevent sleep. Not unfrequently there is more or less deafness, and usually loss of smell and taste. Herpetic spots often appear about the mouth, and the nostrils may become ulcerated from the discharge; the throat is more or less red and swollen, and often there is stiffness and pain of the neck, and tenderness on pressure over the larynx.

After these symptoms have continued for two or three days they generally gradually subside; but the cough may continue troublesome, and the patient be able to take very little food, and may still feel weak for a week or more. In persons of delicate constitution also, the weakness is often very persistent; and, if care be not taken, more serious inflammation of the bronchial mucous membrane or of the lungs may supervene, and may lapse into phthisis.

Treatment.—In the slighter forms of common cold, but little treatment is required except the use of the ordinary household remedies: the feet may be placed in hot water, some warm diluent beverage may be taken, and a light diet must be had recourse to for a day or two. In the more serious cases febrifuge medicines may be given, with an anodyne to relieve the cough, if troublesome, or to procure rest at night, if the neuralgic pains be very severe. When the attack has continued for two or three days a more stimulating diet may be given, and during convalescence tonics and stimulants may be required.

Dr. Ferrier recommends in catarrh the local application to the nose of the following powder in the form of a snuff—Hydrochlorate of morphia 2 grains, subnitrate of bismuth 6 drachms.

gum-acacia in powder 2 drachms. From one-quarter to one-half of this may be taken in the course of twenty-four hours.

It not unfrequently happens that in delicate persons a cold is very difficult to get rid of, and the slightest exposure is followed by an aggravation or renewal of the symptoms. When this is the case the most effectual remedy is change of air, and the patient after leaving home often rapidly improves and soon gets well.

THOMAS B. PEACOCK.

CATARRHAL (*κατὰ*, down, and *ῥέω*, I flow).—Pertaining to catarrh, both in its pathological and in its clinical signification—*e.g.*, catarrhal products, catarrhal pneumonia, catarrhal fever, catarrhal attack.

CATHARTICS (*καθαίρω*, I cleanse).—This word is sometimes used as a synonym for purgatives; but in a more limited signification it means purgatives of moderate activity. *See* PURGATIVES.

CAUSES of Disease. *See* DISEASE, Causes of.

CAUSTICS (*καίω*, I burn).—DEFINITION.—Substances or measures which destroy organic tissues with which they may be brought in contact.

ENUMERATION.—The caustic substances in most common use are Potash, Soda, and Lime; Nitric, Hydrochloric, Sulphuric, and Glacial Acetic Acids; Red Oxide, Acid Nitrate, and Perchloride of Mercury; Carbolic Acid; Chromic Acid; Chloride of Zinc; Chloride of Antimony; and Arsenic. The ordinary caustic measures are the galvano-cautery; the red-hot iron; and moxæ. *See also* POISONS.

USES.—Caustics are chiefly employed to destroy unhealthy, exuberant, or malignant growths; to establish issues for the purpose of counter-irritation (*see* COUNTER-IRRITATION); and to destroy poisons when introduced into the body by breach of the external surface.

T. LAUDER BRUNTON.

CAUTERETS, in the French Pyrenees. Sulphur Waters. *See* MINERAL WATERS.

CAVERNOUS.—A peculiar quality of sounds heard on auscultation of the lungs, indicative of the presence of a cavity. *See* PHYSICAL EXAMINATION.

CAVITY, Pulmonary.—As the result of certain morbid processes which terminate in the destruction of portions of the pulmonary tissues, abnormal spaces or excavations are frequently formed in the lungs, which are designated *cavities* or *vomicæ*. These are usually associated with, and are by far most important in that large class of cases which are grouped under the term Phthisis. They may, however, originate under other conditions, namely, as the result of abscess or gangrene of the lung; of the destruction of morbid growths or hydatid cysts; of dilatation of the bronchi; or of destruction of the pulmonary tissue from without, in connection with glandular disease, empyæma, and other lesions. The most recent observations on this subject are given in the article VOMICA.

Pulmonary cavities present wide variations in different cases as regards their number, size, shape, condition of their walls, amount and nature of their contents, and other particulars. Usually they begin to form in the upper part of one lung, but subsequently they are produced in other parts, frequently both lungs becoming more or less involved, and any portion may be excavated in the first instance. A cavity frequently goes through certain stages, namely, those of formation and extension; of arrest; and of healing or contraction, which may terminate in ultimate closure and obliteration of the vomica. Enlargement of cavities is effected either by progressive implication of their walls, terminating in their disorganisation and removal; or by coalescence of adjacent spaces, the intervening lung-tissue becoming destroyed. During this process of destruction some of the tissues often escape more or less, especially the vessels, which may not uncommonly be seen traversing the spaces or running along their walls, their channel being obliterated. When an excavation is arrested in its progress, it becomes lined by a smooth membrane, and a more or less purulent fluid is secreted within it. This cessation of active mischief may not take place until a whole lobe, or even the greater part of the lung, is involved, a huge cavity being formed, which presents no tendency to contract. In other instances the progress of destruction is stayed, the formation of purulent matter is checked and finally ceases, a fibroid tissue forms, and the space undergoes a process of contraction or cicatrization, which may end in a complete cure, but more commonly merely diminishes the size of the vomica more or less. At a post-mortem examination in cases of phthisis it is common to find numerous cavities in the various conditions and stages indicated above. Occasionally a vomica gives way into the pleura, followed by pneumothorax and its consequences.

Clinically, the existence of cavities in the lungs can only be ascertained positively by physical examination of the chest, and as a rule not only their presence, but their conditions may by this means be determined with tolerable accuracy. The physical signs vary considerably in different cases, and are more conveniently described in other articles. *See* PHTHISIS; PHYSICAL EXAMINATION, and VOMICA. FREDERICK T. ROBERTS.

CELL (*cella*, a closet or store-room).—The term 'cell' was for a long time applied, in anatomy, to various spaces in the body large enough to be recognised with the naked eye. In the *Anatomie Générale* of Bichat, for instance, it was used exclusively for the irregular spaces in areolar tissue (still often called *cellular tissue*). An entirely different sense of the word was introduced from botanical science. The microscope had shown that the structure of plants was largely made up of hollow bodies, called bladders, vesicles, or cells, in which various substances were enclosed or stored up. Schwann was the first to show the similarity in structure of many animal tissues, which were likewise made up of minute parts. These parts were assumed to be, as in plants, hollow; and in both cases, cells were defined as composed of a cell-wall, cell-contents, and a smaller included mass called the nucleus.

This conception of a cell still holds its ground in the anatomy of plants. It did so in animal histology till about the year 1861, when Beale, Brücke, and Max Schultze almost simultaneously showed that many so-called cells in animal tissues did not possess the typical structure of a cell, but were homogeneous masses of a substance resembling the bodies of many lower animals, which substance Schultze distinguished by the name of *protoplasm*. This was first shown to be true of certain special cells, such as the corpuscles of blood and lymph, but afterwards extended more widely, till now it is doubtful whether any minute elements in the higher animals, with the possible exception of the fat-cells when gorged with fat, and certain peculiar forms of cell on the mucous surfaces, come under the old definition of a cell. When the conception was altered, it would probably have been better to have introduced a new name. This, however, was not done, and hence the word cell as now used involves some inconsistency.

By 'cell,' we now understand a mass of contractile, colloid, living matter called *protoplasm*, containing at some period or other a smaller structure called the *nucleus*. It must remain uncertain whether the nucleus is or is not essential to the cell, till we know more about the nature and function of the former; and these points, in spite of the very numerous researches on the nucleus which have lately appeared, must be regarded as still obscure. Sometimes the superficial portion of the cell-body may become hardened or otherwise altered, so as to form what is called a 'cell-wall,' but this is not to be regarded as a separate structure. In cells destined for special purposes the protoplasm becomes modified. *See* NUCLEUS in APPENDIX.

Protoplasm is a nitrogenous, albuminous, colloid substance, having certain properties called *vital*, that is, the power of altering its form under the influence of stimuli, or, apparently, spontaneously. This power may be lost, under the influence of too powerful stimulation or other causes. Protoplasm does not appear to exist in the higher animals otherwise than in the form of minute masses or cells, but it would be rash to say that it cannot exist in continuous masses, as in certain forms of plants.

Many of the properties of cells are the properties of protoplasm. Those cells which consist of unmodified or undifferentiated protoplasm possess contractility, the power of protruding their substance in the form of processes, of undergoing various changes of form, and even of locomotion. In these respects they resemble very simple animals—*amœbæ*, whose bodies are composed of homogeneous protoplasmic substance, and these movements are hence called *amœboid*, or simply vital. Cells which possess these properties may lose them, or die from excessive heat, cold, removal from the body, or other injurious influences. Hence the amœboid movements are especially characteristic of recently formed or young cells. They are seen in the white cells of the blood, lymph-corpuscles, the round or unfixed cells of connective tissue, the young cells which appear in inflamed parts, fresh pus-cells, and occasionally in the young cells of new growths, but are absent as a rule in cells highly differentiated and serving some special purpose, such as nerve-cells, secreting cells, and the fixed cells of connective tissue. Amœboid cells are sometimes found in tissues to the fixed elements of which they have no relation, and are then to be regarded as emigrant or migratory cells. They are very important in some pathological processes.

Cell-proliferation.—Cells increase in number by fission, and perhaps, as some think, by gemmation and by endogenous development. These processes collectively are called cell-proliferation, which is doubtless the source of many of the new cells found in pathological states. All cells are not equally capable of proliferation, which is chiefly seen in amœboid cells, and in all the elements of connective tissue. This tissue was regarded by Virchow as the *germinal* tissue, from which all others originate, but the balance of opinion is now in favour of a different view, namely, that each kind of tissue, by proliferation, produces only tissue of the same kind. Recent researches show that cell-division takes place in two distinct modes, the direct and the indirect. *See* NUCLEUS. The mode of proliferation in epithelial cells is still imperfectly understood. It was formerly held by Schwann and others, that cells originated spontaneously in a homogeneous blastema; but proof is quite wanting of this mode of origin, and it is in accordance with all experience to believe that new cells are always the descendants of pre-existing cells—a conclusion summarised by Virchow in the words *omnis cellula e cellulâ*. It does not follow that new cells are always descended from the cells of the tissues in which they are found, since they may have emigrated from the blood-vessels.

Shape of cells.—Amœboid cells have, strictly speaking, no fixed shape; but in a state of rest, and when dead, they are nearly spherical. Some cells of similar protoplasmic composition are very irregular in shape, and contain many nuclei, namely, myeloid or giant-cells. Other cells have various shapes, of which the commonest is an elongated form, with a process at each extremity, as in fibre-cells; some, as nerve-cells or fixed connective-tissue cells, are stellate, with several processes. Some cells in certain new growths, especially tubercle, also called giant-cells, have extremely complicated processes.

Wasting and Degeneration of cells.—The actual duration of life in cells is not in all cases precisely known; but in the blood and in large collections of amœboid cells we always find some with signs of decay and death, so that their life is probably measured by days. Epithelial and secreting cells have also a limited duration, while fixed cells of connective tissue and nerve cells are probably more permanent. Cells are also subject to the degenerations which affect tissues generally, especially the fatty, mucous, and colloid. The obvious pathological changes in organs are often due to the minute changes in the cells. Newly-formed cells are more subject to degeneration and decay than the original elements; and this is especially true of cells produced in inflammation. Some pathological processes consist essentially in the rapid production, followed by rapid

degeneration, of new cells, for example, scrofulous inflammation.

Cellular Pathology.—This name is given to the system which explains morbid processes by reference to the independent life of cells, their active properties, their proliferation, and their degenerations, while it attaches less importance to derangements of the circulation, or to alterations in the composition of the blood. Its foundations were laid by Remak and Goodsir, but it was first reduced to a comprehensive system by Virchow, not only in his work thus named, but in memoirs published before and since. The cellular pathology explains many facts which were before obscure, and the important steps thus made are not likely to be retraced; but in several points modification of Virchow's views has become necessary. As to the origin of new-growths, it is not now held that all arise or can arise from the connective tissue; and in inflammation it is agreed that the changes of the tissues, however well-established, are only of subordinate importance, as compared with those depending upon the circulation.

J. F. Payne.

CELLULITIS.—Definition.—Cellulitis is the term applied to inflammation of the cellular or loose connective tissue, whether the subcutaneous areolar tissue, or that interposed between muscles and viscera, or surrounding various organs.

The areolar connective tissue is so universally distributed throughout the body that it is necessarily concerned in most inflammations—no matter of what structure—and in it, in fact, the chief changes generally take place.

To consider completely the pathology of inflamed connective tissue would be more or less to review the whole series of the acute diseases. We must limit our consideration to cases in which the cellular tissue is the chief or only tissue involved, or where changes in other parts are secondary to those primarily affecting the cellular tissue.

Beneath the skin, over the whole surface of the body, lies a layer of this tissue, containing within its meshes more or less adipose matter. It will be convenient to consider the changes which occur in it when inflamed, as they are identical with those in cellular tissue elsewhere.

Inflammation of the subcutaneous cellular tissue may be *diffuse* or *circumscribed*. The former is nearly always acute in type, and the latter often, but not invariably so. A *chronic* form of cellulitis causing thickenings is observed in various regions, or it may be a sequel to the acute disease.

1. Circumscribed Cellulitis.—Ætiology.—Any injury to a part, whether of the nature of a wound or contusion; an impacted foreign body; or a fragment of bone, may cause cellulitis. Pyæmia or septicæmia, any decomposing secretion in a wound, altered blood, or infiltrated urine are prone to produce marked inflammatory changes in the connective tissue in different parts of the body. The poison introduced in a dissection- or *post-mortem* wound often occasions an acute cellular inflammation. Frostbite, burns, inflammation of muscles, arteries, veins, or periosteum may produce inflammation of the adjacent cellular tissue: thus, inflammation of the kidney may cause perinephritis; inflammation of the uterus may lead to pelvic cellulitis; or some mischief in the greater bowel or rectum may produce inflammation and abscess in the loose cellular tissue around them (*Perityphlitis*); the poison also of scarlatina causes cellulitis of the submucous areolar tissue of the throat; and *Angina Ludovici* is the name given to the cellulitis of the floor of the mouth and neck which is often associated with pyæmic symptoms. A *sympathetic bubo* is an irritated lymphatic gland causing inflammation of the cellular tissue around it.

Pathology.—Pathologically, connective tissue is of the greatest importance in the organism, being the most frequent seat of inflammatory and other changes. Areolar tissue mainly consists of loosely interlaced bundles of fibrous tissue, with flattened connective-tissue corpuscles adherent to them, and leucocytes, or amœboid corpuscles, in the intervals. The exact *rôle* played in inflammation by the cellular elements is not quite settled. Under ordinary circumstances the leucocytes doubtless proliferate, and the fixed corpuscles probably do so also. Even under the influence of a slight irritation the flattened corpuscles in a few hours become globular, and present many nuclei in their interior—changes certainly pointing towards proliferation; while the very rapid increase of cells which takes place points to their derivation from cells pre-existing in the part, although the immigration of leucocytes from the blood into the inflamed part adds considerably to their numbers. Whether the perversion of nutrition which forms the starting point of the disease first induces a local cell-proliferation, or an immigration of leucocytes, or what proportion these two processes bear to each other, is difficult to determine.

The disease consists essentially in a very active cell-proliferation and increase. Whether the cellulitis be circumscribed or diffuse, similar changes occur; the difference between them being that in the former there is formed a limiting zone of vascular tissue resembling granulation-material, which is absent when the inflammation is diffuse. There are otherwise no anatomical differences. When cellular tissue inflames, the part swells from the serofibrinous exudation poured out from the distended capillaries; its meshes are filled with young round cells, partly by proliferation of the connective-tissue corpuscles, in part by the accumulation of wandering leucocytes; the circulation is interfered with by the pressure of the effusion, complete stasis sometimes taking place. While the cell-increase is proceeding, the fibrillar intercellular substance gradually disappears, in part by necrosis, and in part by becoming liquefied; and the tissue is finally transformed into pus. When this has happened the deeper layers of the skin disintegrate; it becomes undermined and gradually thinner; necrosis in one or more places follows; and the pus mingled with shreds of dead cellular tissue escapes, the latter resembling nothing so much as soaked washleather. The pus, at first thin and serous, subsequently becomes laudable. There is always a great tendency to suppu-

TUBES OF NUTRIENT AGAR
ILLUSTRATING THE
INHIBITORY ACTION
OF
LISTERINE.

BOTH TUBES IMPREGNATED WITH BACILLUS PYOSCYANEUS.

AGAR.

AGAR WITH 20% LISTERINE.

BOTH TUBES IMPREGNATED WITH SARCINAE AURANTICA.

AGAR.

AGAR WITH 20% LISTERINE.

BOTH TUBES IMPREGNATED WITH BACILLUS PRODIGIOSUS.

AGAR

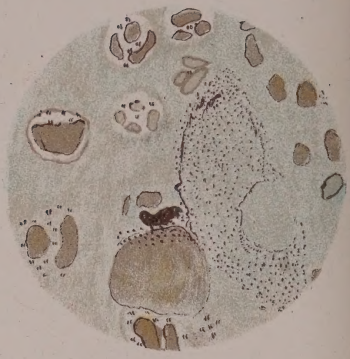
AGAR WITH 20% LISTERINE.

BOTH TUBES IMPREGNATED WITH SACCHAROMYCES RUBER.

AGAR.

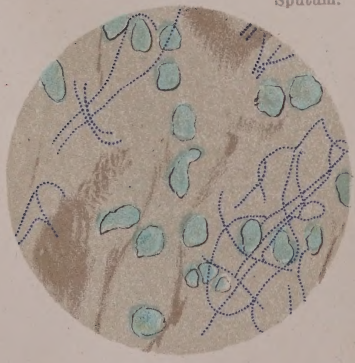
AGAR WITH 20% LISTERINE

Typhoid Bacilli. With flagella x 900.

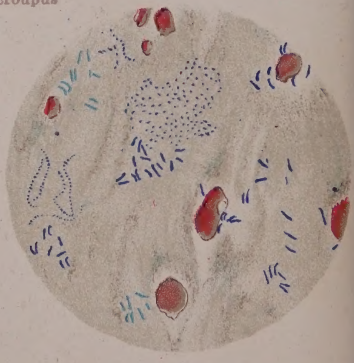


Gonococci and Staphylococci.
Mixed infection x 850.

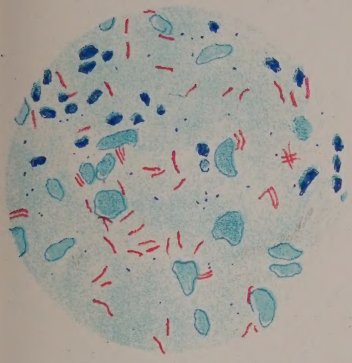
Sputum. From case of acute croupus pneumonia x 750.



Streptococcus Pyogenes x 850. With lymph corpuscles from case of non-diphtheritic croup.

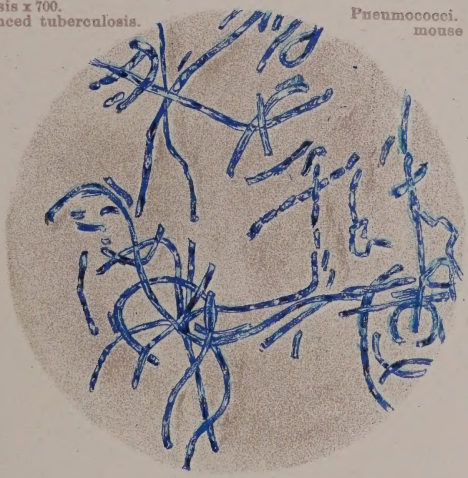


Bacillus Diphtheriæ
Streptococcus and Staphylococcus.
Membrane from case of Diphtheria showing mixed infection x 700.



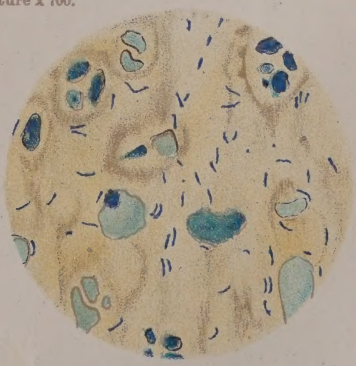
Bacillus Tuberculosis x 700.
Sputum from case of pronounced tuberculosis.

Pneumococci. From pleuritic exudation of mouse after pneumonia x 700.

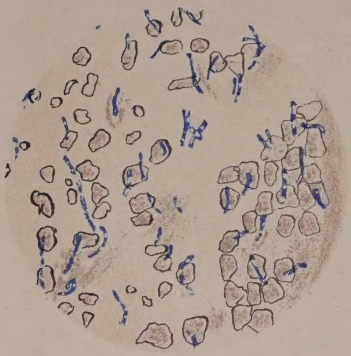


Bacillus Anthracis. From culture x 700.

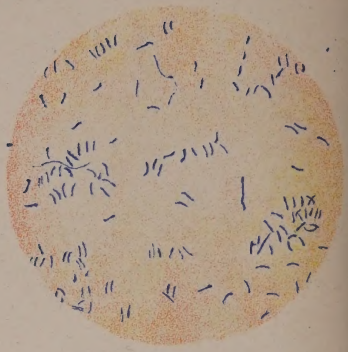
Bacillus Influenzæ x 700.



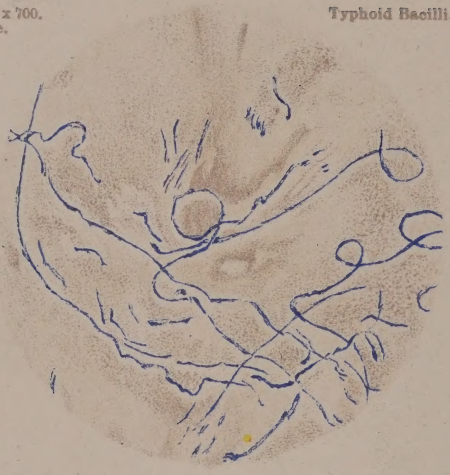
Bacterium Coli Commune x 700.



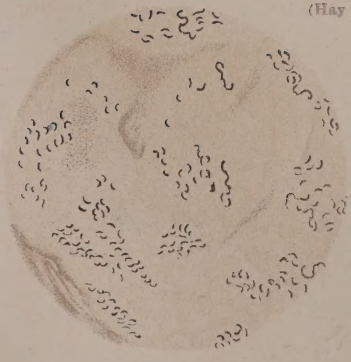
Bacillus Anthracis x 700.
Spleen of mouse.



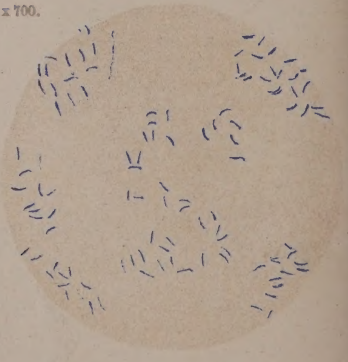
Typhoid Bacilli. From pure culture x 700.



Bacillus Subtilis.
(Hay Bacillus) from culture x 700.



Koch's "Comma Bacillus"
Of Asiatic Cholera x 700.



Bacillus Diphtheriæ. From culture x 700.

ration, the vitality of areolar tissue being very low; but resolution sometimes takes place without formation of pus. The cells then develop into fibrous material and the ordinary phenomena of a cicatrix result. The consequences of cicatrisation differ greatly, according to the tissue or organ involved and the extent of the disease; but essentially they are similar everywhere. A gradual contraction sets in. In external parts we can observe atrophic changes taking place, followed sometimes by deformity or loss of function, while in the viscera the condition is known as cirrhosis. The special tissue of an organ or of a muscle cannot be reproduced; it is replaced after an injury by connective-tissue cicatrix. In such tissues as bone, tendon, and nerve, however, the cicatrix will be converted into the normal tissue of the part.

Symptoms.—The amount of fever varies with the extent of the disease and the nature of the cause; when the cellulitis is quite limited there may be little or none, but deep-seated or extensive cellulitis produces considerable constitutional disturbance. Painful swelling of the inflamed part will first be observed; the skin soon becomes tense, red, and œdematous, although at the outset it is sometimes paler than normal. The redness is gradually lost towards the periphery of the swelling, and is darker, or of a bluish-red tint in the centre, from the obstruction to the exit of blood; the swelling is doughy, inelastic to the touch, and pits on pressure. The inflamed region feels hard, the induration ceasing by no well-defined border. If resolution occur all these symptoms subside. A greater or less amount of thickening of the tissue may, however, persist—often for a lengthened period—the parts gradually returning to their normal state. Suppuration is, however, the rule; and when it occurs the pain and tension diminish, fluctuation is felt,—obscure at first,—the pus by degrees approaching the surface, and escaping spontaneously, or by an artificial outlet which may be provided. When the inflammation is more deeply placed, especially when beneath strong fasciæ, there will at first be no perceptible redness or swelling of the skin, or only a slight pinkish hue, with some œdema, to indicate the changes taking place beneath; and fluctuation may be difficult or impossible to make out long after pus has formed; but the pain and fever are more considerable. This variety of the disease may also terminate in resolution—especially when early and appropriate treatment has been adopted; or in suppuration. It may also become chronic, or relapses may take place after temporary amendment. If the cause of irritation be a slight one, but repeatedly renewed, permanent thickenings or atrophic changes in the tissue may result; or the circumscribed may be converted into diffuse cellulitis. A very intense irritant sometimes induces gangrene. The same thing may happen if a previously diseased tissue be attacked, as an anasarcous limb; or pressure, associated with the cellulitis preceding bed-sores, may be sufficient to cause it.

2. Diffuse Cellulitis. Synon.: Diffuse phlegmon; Pseudo-erysipelas; Diphtheria of the cellular tissue. This is a severe disease attended by general symptoms of a marked character, frequently associated with septicæmia, of which it may be both a cause and an effect.

Ætiology.—The most frequent cause of diffuse cellulitis perhaps is some form of septic poisoning. In the extremities the disease may originate from some trifling cause, especially in those whose constitution is impaired by age, privation, or excess; in the hand and forearm of such persons it is especially common after wounds on the finger or an insignificant whitlow. In convalescence from acute febrile diseases, especially typhus or typhoid, a local phlegmon is sometimes transformed into a diffuse cellulitis.

Symptoms.—The local symptoms of diffuse cellulitis resemble those of the circumscribed form, but are more intense, and accompanied by severe constitutional disturbance.

A sudden chill with elevation of temperature often ushers in the attack; the rigor may recur at intervals, but sweating is unusual, and vomiting infrequent. In the affected region the patient experiences a sense of weight and great distension, with severe dragging pain. When the inflammation is deep-seated the redness of the skin may not be well marked, even after a considerable extent of the cellular tissue has sloughed. This character is a very dangerous one, because it leads to the nature of the affection being for a time overlooked and efficient aid postponed. When the skin participates, the redness is darker in hue, less sharply defined, and less easily dispersed by the pressure of the finger than in the cutaneous inflammation of erysipelas, while it soon becomes œdematous. The affected part feels brawny, hard, and swollen throughout, and extremely tender and painful; sleep is impossible; any movement causes great suffering; the fever is often very high; the secretions are diminished; and the appetite is lost. Sweating and rigor presently announce the formation of matter; the swelling becomes less prominent and more soft; the skin is mottled, thin, and yielding in places; and the fever and pain subside. Convalescence may take place on the evacuation of the pus; or the rigor may be renewed, the fever reappear or continue, and the patient sink with symptoms of blood-poisoning. The more deeply the inflammation extends the more tedious is recovery, and the more liable is the patient to relapse; or the muscles, tendons, and adjacent joints may become involved in the suppuration; or perforation of a dangerous character of neighbouring cavities or organs may take place. Suppuration consequent upon diffuse cellular inflammation will sometimes extend up the fore-arm to the elbow, undermine the skin, dissect the muscles, open into the finger- and wrist-joints, cause necrosis of tendons, and terminate in the loss of the limb by amputation, or perhaps in loss of life from septic poisoning; should recovery ensue, the limb is permanently crippled from the matting together of muscles and tendons, the immobilization of the joints, and the adhesions that take place between tissues which should freely glide over one another. Suppuration is the rule, but under favourable circumstances and with early and suitable treatment it may occasionally be prevented. Usually pus has already formed when the case comes under observation, and

the surgeon has only to use his bistoury to limit the spread of the disease.

The irregular cavities and sinuses left after the evacuation of the dead tissue often suppurate for a long time, and may thus induce amyloid degeneration of the viscera. The thromboses which form of necessity in the smaller veins implicated in the inflamed area may break down and lead to septic embolism and pyæmia. The risk of this complication is a serious and ever-present one in these cases.

Diagnosis.—Cellulitis has chiefly to be diagnosed from erysipelas. Erysipelas may involve the subcutaneous tissues, and cause inflammation and suppuration of the connective tissue, but it always begins in the skin, which is more extensively affected. Inflammation of the cellular tissue begins beneath the skin, where the swelling and effusion first take place, the skin becoming involved later and usually to a less extent, while it may remain, at least for some time, almost entirely free; the redness, too, is less bright, and more diffused, not presenting the distinct margins of erysipelas, but fading into the surrounding parts.

In the later stages the two diseases are scarcely distinguishable. At first it may be difficult to decide whether the case is one of inflammation of the subcutaneous cellular tissue, of the perimuscular areolar tissue, or of that connected with the periosteum, or around a vein. The greater the general swelling of the limb, the more considerable the fever and the pain, and the less the redness of the skin, the more probable is it that the inflammation affects deeply seated structures.

Prognosis.—The prognosis depends on the extent of the disease and the constitution of the patient.

Treatment.—The local cause should be removed, so far as may be practicable. If the wound be in a foul condition it should be rendered aseptic. Absolute rest to the inflamed part is of great importance. So long as suppuration has not occurred, resolution is possible. Methodical pressure, once advocated, cannot usually be tolerated. Blistering is not employed in the acute form, but may be useful in removing more chronic changes. Cold applications and ice abate pain and inflammation, and limit the disease, even if they do not prevent suppuration. In the more advanced stages, especially when they tend to become chronic, they are useless or even dangerous, from their liability to cause gangrene in debilitated subjects. Local blood-letting does not prevent suppuration, and is usually contra-indicated by the weak state of the patient. When pus forms, or its presence is suspected, a sufficiently free outlet should be provided for it as soon as possible. Nothing so effectually checks the further spread of the disease. The incision should be made at the most prominent point. It is better to make a number of small incisions, from half an inch to an inch in length, than one long one, which is apt to be followed by dangerous bleeding, and does not relieve the strangulated tissues so efficiently. When suppuration is only suspected, incisions should nevertheless be practised without delay, without waiting for fluctuation. Pus and shreds of dead cellular tissue should be frequently washed out of the wound with an irrigator. No force should be used to remove portions of dead tissue: any dragging tends to rupture the small blood-vessels, and to destroy the remaining connexions of the skin with the deeper structures. Antiseptic precautions must be zealously carried out.

When a joint becomes involved, or when the patient is thoroughly exhausted by the quantity of discharge, and the tissues spoiled, amputation is often necessary. Excision may be practised if the condition of the soft parts admits of it.

The general treatment consists in giving nourishing food and stimulants, combined with opiates to relieve pain, and iron, quinine, and other tonic medicines. William MacCormac.

CEPHALALGIA (κεφαλή, the head, and ἄλγος, pain).—Pain in the head. *See* Headache.

CEPHALHÆMATOMA (κεφαλή, the head; αἷμα, blood; and ὁμός, like).—Definition.—An effusion of blood occurring in newly-born infants, forming a tumour upon the head; situated beneath the pericranium, upon the surface of the skull; or more rarely beneath the skull, between it and the dura mater.

Description.—This disease is of very rare occurrence, and must not be confounded with the *caput succedaneum*, which is an effusion of serum external to the pericranium, and is of common occurrence. The blood is generally extravasated immediately beneath the pericranium, over one of the parietal bones, most frequently the right, but it may occur over the frontal or occipital. Combined with this, or arising independently, but of extreme rarity, may be an effusion beneath the cranium. The origin of cephalhæmatoma has been attributed to a variety of causes, but is most probably due to the constriction of the margin of the os uteri during labour. It is generally observed some hours or a day after birth, as a circumscribed swelling, slightly tense and fluctuating: and its peculiarity consists in a bony circle surrounding and limiting it.

Diagnosis.—These tumours have been mistaken for hernia cerebri, but their situation over the bone away from the fontanelles, the absence of pulsation, and the existence of fluctuation in cephalhæmatoma should prevent confusion.

Prognosis.—Generally the blood becomes absorbed, but occasionally suppuration occurs, or the bone may become necrosed; if beneath the skull, serious consequences, including idiocy, may ensue.

Treatment.—As a rule, cephalhæmatoma is not to be interfered with. If suppuration take place the pus must be evacuated.

Clement Godson.

CERATITIS. *See* Keratitis.

CEREBELLUM, Lesions of.—The cerebellum is liable to the same diseases as the brain and nerve-centres generally, such as hæmorrhage, abscess, various forms of degeneration, tumours, &c. The nature of the pathological condition is to be determined by the symptoms peculiar to each, so far as this is possible. Its locality in the cerebellum is to be diagnosticated, first, by certain symptoms which

are due to the cerebellar lesion as such, which may be termed the *direct* symptoms; and, secondly, by those symptoms which depend more on the influence exerted by the lesion on neighbouring or subjacent centres and structures. These latter may be termed the *indirect* symptoms.

It is by no means easy to separate these symptoms from each other, and to say how much is due to interference with the functions of the cerebellum, and how much to interference with the functions of other parts. There are few diseases which have a purely local organic or functional limitation. Hence, in order to arrive at the symptoms peculiar to cerebellar lesions, it is necessary to exclude all pathological affections which in their very nature affect the whole of the intracranial centres, *e.g.* tumours, meningitis, &c. The most satisfactory conclusions from a pathological point of view are to be drawn from cases of atrophy or degeneration of the cerebellum, and, from a physiological point of view, from the results of experimental lesions of this organ in the lower animals.

The evidence from these two sources is mutually supporting.

Direct Symptoms.—The characteristic symptoms of cerebellar disease are disorders of equilibrium, shown, on attempts at locomotion, in a reeling or staggering gait (titubation), and a continual tendency to stumble or fall over the most trifling obstacle, or on hurried movements.

These symptoms may be confounded with locomotor ataxy, but careful observation will show that in cerebellar disorders there is no true ataxy of co-ordination. The movements are quite co-ordinated with each other, and are such as would instinctively be made to prevent falling, or to preserve the equilibrium; and have none of the precipitate, irregular, and sprawling character seen in ataxy. They are not specially intensified on closure of the eyes, which is such a marked feature in ataxy. Nor are they accompanied by any of the sensory affections of ataxy, whether in the form of pains or anæsthesia.

There is no true motor paralysis in cerebellar disease as such, and the various volitional movements of the limbs can be carried out perfectly well in the recumbent posture. Sensation, general and special, is not directly affected in cerebellar disease. Nystagmus and strabismus have been observed, more particularly in connection with lesion of the cerebellar peduncles. Defects of articulation have been noticed, but it is very doubtful whether they should be regarded as direct symptoms.

It is to be noticed that in some cases of slowly progressive degeneration of the cerebellum, the disorders of equilibrium are not observed to any marked extent, an occurrence to be accounted for in all probability by compensatory action on the part of other centres.

Indirect Symptoms.—*Pain in the head*, more particularly at the back, though not constantly situated there, is frequently associated with organic disease of the cerebellum.

Vomiting is also very frequently observed, perhaps more constantly than in connection with diseases of other parts of the brain. There is, however, no reason to regard this as due to cerebellar disease as such. It is probably due to indirect effects on the medulla. As a general rule, diseases tending to encroach on the space of the posterior fossa or to increase the pressure on this region, have a similar effect.

Hemiplegia is not uncommon in connection with cerebellar disease, and more particularly in cases of tumour or hæmorrhage into the lateral lobe of the cerebellum. The hemiplegia is on the side opposite the lesion. This does not prove that the hemiplegia is due to the destruction of the cerebellar lobe, or that the cerebellar lobes have cross relations with the limbs. Experimental physiology and anatomical investigations tend to show that the cerebellar lobes are functionally related to the motor tracts on the same side. This is also borne out by the fact that atrophy of the lateral lobe of the cerebellum follows disease and degeneration of the opposite cerebral hemisphere. The hemiplegia from cerebellar disease is, therefore, in all probability, due to compression or some affection of the subjacent motor tracts, which decussate at the pyramids. The fact that it occurs chiefly when the disease is limited to the lateral lobe is what might be expected on anatomical grounds.

Affections of sensation, common and special, have been observed in cases of cerebellar disease. Diminution of tactile sensation on the opposite side of the body, when the disease is situated in the lateral lobe, is to be accounted for in the same way as the motor paralysis. As regards the special senses, affections of sight have been most frequently noted. Sight is certainly not abolished by destruction of the cerebellum in the lower animals, and when blindness occurs in man in connection with diseases of this organ, it is either due to implication of the corpora quadrigemina, functionally or organically, or to secondary degeneration in the optic tracts, as the result of increased intracranial pressure or descending optic neuritis.

A special feature of *tumours* of the cerebellum, more especially of the middle lobe, is a tonic rigidity of the muscles of the back of the neck, with retraction of the head, associated frequently with flexion of the forearms and extension of the lower extremities and pointing of the toes. In these cases also, psychical affections, more particularly mental hebetude or stupor, occur as the result of secondary dropsy of the ventricles, caused by pressure on the veins of Galen. The symptoms then become those of hydrocephalus.

Hæmorrhage into the middle lobe of the cerebellum, in addition to the ordinary symptoms of apoplexy, has been frequently found to cause vascular excitement of the genital organs—in the male marked *priapism*. This symptom, of which several cases were first reported by Serres, led this observer to modify the view of Gall that the cerebellum, as a whole, was related to the sexual instinct, and to regard the middle lobe only as having any such function. The facts, however, are susceptible of a totally different interpretation, and one more in harmony with other data of physiology and pathology. It has been found experimentally by Segalas and by Eckhard that irritation of the posterior surface of the medulla and pons gives rise to vascular excitement of the generative

organs, and hence the symptoms in cases of hæmorrhage into the middle lobe are to be ascribed to irritation of this region. This fact also explains the absence of the symptoms when the hæmorrhage occurs into the lateral lobes. There is absolutely no evidence of the slightest value in support of Gall's hypothesis. The facts of clinical medicine go a considerable way in diametrical opposition to it, if they are not themselves sufficient entirely to overthrow it.

Cerebellar Peduncles. — Respecting the effects of disease of the restiform tracts or inferior cerebellar peduncles we have no definite knowledge.

Cases, however, are on record in which lesions have been found involving principally either the superior or middle cerebellar peduncles. The symptoms, in the main, agree with those observed by Magendie on section of the middle peduncle in the lower animals. The chief effect of this lesion was to cause an irresistible tendency to roll over towards the side of lesion. Together with this rotatory disturbance of the equilibrium, a peculiar distortion of the optic axes was observed, the eye on the side of lesion being directed downwards and inwards, the other looking upwards and outwards.

In a case described by Curschmann (*Deutsch. Archiv f. Klin. Med.* xii. 356), along with appearances of basilar meningitis, which somewhat complicate the case, there was found a focus of softening, surrounded by capillary hæmorrhages in the right superior cerebellar peduncle. The symptoms observed in this case were a rotatory distortion to the right side, to which position the patient invariably returned when resistance to this movement was withdrawn. There was no motor paralysis, nor was there any distortion of the optic axes.

A case has been put on record by Nonat (*Comptes Rendus*, 181) of apoplectic extravasation into the right middle peduncle of the cerebellum and right cerebellar hemisphere. In this case the head and trunk were twisted towards the right side, and the ocular symptoms were also present, the eyes being immovable in a position of skew deviation. Other cases are on record in which the cerebellar peduncles have been involved in more extensive lesions; but the symptoms, though not opposed to those above related, are incapable of differential analysis. The special diagnostic symptoms, therefore, of lesion of the cerebellar peduncles are what are frequently termed 'forced movements' (*Zwangsbewegungen*), or distortions of the normal axis of the trunk. The exact direction of the distortion, in consequence of lesion specially limited to one or other peduncle on the right or left side respectively, is somewhat doubtful, though as a rule it has been found towards the side of lesion. Much, however, will depend on whether the lesion is of an irritative or inflammatory, or of a destructive character. A lesion of an irritative nature, though occupying the same position as a destructive lesion, would exactly reverse the direction of the distortion of the head and trunk. D. Ferrier.

CEREBRAL ABSCESS. *See* Brain, Abscess of.

CEREBRAL APOPLEXY. *See* Apoplexy, Cerebral.

CEREBRAL ARTERIES, Diseases of. *See* Brain, Vessels of, Diseases of.

CEREBRAL HÆMORRHAGE. *See* Brain, Hæmorrhage into.

CEREBRITIS.—Inflammation of the brain-substance. *See* Brain, Inflammation of.

CEREBRO-SPINAL FEVER.—Synon.: Epidemic Cerebro-spinal Meningitis; The Black Sickness (popular, Dublin); Fr. *Méningite cérébro-spinale épidémique*; Ger. *Cerebral-typhus; Epidemische-meningitis.*

Definition.—An acute epidemic febrile disease, characterised by sudden invasion, with extreme nervous shock, vomiting, excessive pain referred to the back of the neck and spine, spasmodic contraction of muscles, excessive sensibility of the skin, and frequently delirium; accompanied by purpuric eruptions, either circumscribed, raised, hard, and shotty to the feel, or extensive purpuric spots or patches, frequently accompanied by vesicular eruptions usually of herpetic but sometimes of a pemphigoid character, and frequently purulent inflammation of the eyes. *Post mortem* there are found: inflammation of the membranes of the brain and spinal cord, especially of the arachnoid, with deposit of white, yellow or greenish-yellow lymph upon the surface of the arachnoid, especially at the base of the brain and anterior portion of the medulla oblongata and spinal cord, and effusion of serum into the ventricles and sub-arachnoid spaces.

Ætiology.—*Age.*—The disease usually attacks those approaching the age of puberty or in early adult life; it is seldom met with after thirty-five years, and is very rare after the age of forty. It is not unfrequent in young children.

Sex.—It is much more frequent in males than females; robust males between the ages of fifteen and thirty are its favourite victims.

Occupation.—It seems specially to attack young recruits in the army, as was the case in the French epidemics. In Dublin it was specially severe among the recruits of the Royal Irish Constabulary stationed in the police barracks in the Phœnix Park. There does not seem to be any other occupation which predisposes to the disease. Excessive fatigue seems to predispose to the disease; it has arisen after a hard day's hunting, foot-racing, long walks, dancing, or in children exhausted from out-door play.

Season and Climate.—It is widely distributed in the temperate zone. It prevails more in cold than in hot weather; in Iceland it has usually prevailed in winter and early spring.

General Sanitary Conditions.—It seems to be less influenced than any other epidemic affection by general sanitary conditions.

Communicability.—It is generally believed not to be contagious; a few doubtful cases of contagion have been recorded; except, however, in cases where it has appeared as an epidemic among recruits, there are few instances of more than one case arising in any particular house or circumscribed locality.

Epidemic Influence.—The disease is undoubtedly epidemic.

Unwholesome Food.—It has been suggested that the disease owes its origin to the use of breadstuffs made from diseased grain.

Anatomical Characters.—Cadaveric rigidity is well marked; large purpuric patches form after death even in cases where there were no purpuric symptoms during life; in some cases the whole body has turned black. On incision a large quantity of dark, tarry-looking blood exudes; the muscles are darker than usual, and in prolonged cases much weakened and wasted. There is increased vascularity of the scalp; the cerebral sinuses are much distended with dark blood; serum is found in the sub-arachnoid spaces and ventricles; all the membranes of the brain may be more or less congested, the arachnoid being always extremely vascular and opaque from deposits of lymph—this opacity varies from slight milkiness to thick and dense deposits. The most marked intracranial lesion is the white-yellowish or yellowish-green 'fibrino-purulent' deposit found at the base of the brain. This deposit varies somewhat with the duration of the disease: in cases which die early the deposit is usually slight, whitish, and soft; in those which live for a week or so the deposit is yellowish or greenish; in prolonged cases the deposit is more white and pure, the effused serum greater in quantity, and the vascular fulness less. The origins of the nerves seem to be buried in and compressed by the deposit. The brain-substance itself is more vascular than normal, but not otherwise altered. In the *spinal cord* the lesions are similar to those found in the brain and its membranes. In some cases purulent infiltration of the eye-ball and effusion into the joints have been met with. The lungs, liver, and spleen have been found much congested in many cases.

Symptoms.—The patient is usually attacked suddenly when in apparently vigorous health by faintness, vomiting of greenish matter, and intense pain referred especially to the back of the head and neck; the extremities become cold; the patient becomes insensible and sometimes convulsed; the limbs become rigid. On recovering from the collapse, the patient complains of great pain in the head, back of neck, and along the spine; the head is drawn back, so as to be almost at a right angle with the spine; the whole back is sometimes arched, as in tetanus, the muscles become rigid, and the skin excessively sensitive; neuralgic pains are also complained of in all parts of the body. In most of the severe cases eruptions appear within the first twenty-four hours; the eruption usually appears first on the legs, and is frequently confined to the lower extremities; the spots are usually black, raised, about a line in breadth, and feel like a grain of shot under the skin; sometimes these raised spots are surrounded by a dark purplish areola; in most cases large purpuric patches of many inches in extent form on various parts and, sometimes coalescing, cover the entire body. Vesicular eruptions are also common; these usually have the character of herpes zoster, and are most frequent on the face, neck, and shoulders. The herpetic eruptions are met with as frequently in mild as in severe cases. Pemphigus sometimes appears in the advanced stages of the disease. When reaction sets in, the temperature is found to have risen to from 100° to 103° or 104° Fahr. In many cases the temperature never rises, and the patient dies in the collapse; the respiration becomes of a sighing character; the pulse rises to about 120, and has a peculiar jerking character, giving a sharp up-stroke to a sphygmographic tracing. The foregoing symptoms are very variable; any one, or even a considerable number of them, may be absent throughout the whole course of the case.

Complications and Sequelæ.—Complications connected with the nervous system are the most common; paralysis of one or more limbs is common, of a hemiplegic character, and most frequently attacking the arm; deafness is not very common, but has been met with in several cases, and sometimes becomes permanent. The eye-complications are among the most frequent and most serious. The eye is frequently attacked with a low form of inflammation, terminating in purulent infiltration of the whole or part of the organ; the cornea is more frequently attacked than any other portion; and this sometimes giving way, the whole contents of the globe escape, causing permanent loss of sight. The sight is also often permanently impaired by iritis, or opacity of the cornea. In many cases, however, the inflammation completely subsides. It is remarkable that it is the right eye which is usually attacked, seldom that both eyes are affected, and scarcely ever the left eye alone. Acute inflammation of the larger joints is a frequent complication in some epidemics; this often terminates in purulent effusion into the joints. Hæmorrhages are frequent in the more malignant forms, and are almost always present in cases where the purpuric blotches are of large extent; these hæmorrhages have occurred from the nose, uterus, bowels, kidneys, and ears in about the foregoing order of frequency. Gangrene is occasionally met with, and the cases in which it occurs are usually fatal. In some cases toes have been lost and the patient recovered; the purpuric patches have also sloughed without serious danger to the patient's life.

Diagnosis.—The disease is liable to be confounded with typhus fever on account of the petechial rash, but is distinguished from typhus by the rash appearing suddenly without any previous mottling of the skin. The nervous symptoms also distinguish it from typhus, although in a case of typhus complicated with cerebro spinal meningitis the diagnosis is extremely difficult, and may be impossible. It is distinguished from *purpura hæmorrhagica* by the intensity of the fever and the localised nervous symptoms. The malignant cases are more likely to be mistaken for malignant scarlatina than for any other disease, and must be distinguished therefrom by the rash, sore throat, and nervous affections. In some cases it has been indistinguishable from malignant scarlatina, especially where death occurred within twenty-four hours, and both diseases were epidemic at the time.

Prognosis, Duration, Termination, and Mortality.—The prognosis, duration, etc., of the disease depend much upon the form the affection assumes, and for convenience we may divide the disease into the following forms:—

1st. Cases of a very mild form, terminating in recovery; the duration being usually from one to three weeks.

2nd. Cases of a very severe form, setting in suddenly; the symptoms being very violent and well marked, accompanied by purpuric spots and blotches, with a tendency to hæmorrhages, with deep collapse and coma; usually terminating fatally in from a few hours to three days.

3rd. Cases of medium severity, where all the nervous symptoms set in with less suddenness than in the second class of cases, purpuric blotches not being usually present, and no hæmorrhages. These usually yield to treatment, and terminate in recovery in from two to six weeks.

4th. Cases which set-in either in a mild or in a severe form, but in which on the subsidence of the fever the strength does not return, convalescence is retarded or ceases altogether, and the patient falls into a general atrophic condition, and usually dies in from three to six months of marasmus.

By deciding to which of the above classes the case belongs, the prognosis will be to a great extent determined. The chief indication of danger is the early appearance of purpuric and hæmorrhagic conditions.

The mortality in cerebro-spinal fever is very high—probably on an average about 60 per cent. In some of the American epidemics it is placed as high as 75 per cent. Among the Irish constabulary it reached 80 per cent. Like other epidemic diseases the mortality is highest at the commencement of the epidemic. It is most fatal about the age of twenty, and less so under fifteen years.

Treatment.—The treatment in the early stage must be directed to recovering the patient from the collapse. This is best done by the application of heat, the administration of small quantities of stimulants or stimulating enemata, and the application of sinapisms over chest and back. In the next stage of the disease attention must be almost altogether directed to allaying the spinal irritation, and promoting the absorption of the effused matters. The extreme irritation will be best diminished by the use of belladonna and bromide of potassium. The pain, which is extreme, will yield best to frequent and considerable doses of opium; indeed many physicians rely altogether on opium as the curative agent. With a view of promoting absorption of the effused matters, mercury and iodide of potassium have been chiefly relied upon. In the more sthenic cases calomel may be employed with benefit in small and repeated doses. The disease being usually of an asthenic type, mercury will seldom be well borne, and iodide of potassium should be preferred. Leeches applied to the back of the neck, behind the ears, or to the temples, produce great relief of the excessive pain in the head and upper part of the spine. The application of ice to the head and spine temporarily allays pain, but there is little evidence of permanent benefit being derived therefrom. In prolonged cases blisters applied along the spine have been favourably spoken of. The local complications must be treated as they arise, and according to general principles applicable in each case. Stimulants are required in considerable quantity in a very large number of the cases which present adynamic symptoms.

T. W. Grimshaw.

CHALAZION (χάλαζα, hail).—A small encysted tumour of the eyelids, colourless and transparent, and resembling a hailstone.

CHALK-STONES.—This name is applied to the deposits which are formed in connexion with the gouty diathesis, especially in the joints. They are thus denominated from their appearance and physical characters, in which they more or less resemble chalk; but in their chemical composition they are entirely different, consisting mainly of urate of soda. *See* Gout.

CHALYBEATE WATERS (*chalybs*, steel). —Mineral waters which contain iron. *See* Mineral Waters.

CHANCRE (Fr. *chancre*).—Hard chancre is the initial manifestation of syphilis. *See* Syphilis. Soft chancre, *see* Venereal Disease.

CHANGE OF LIFE.—Synon.: Climacteric epoch; Sexual involution; Fr. *Mènopause*. Ger. *Menstruationsende*.

Definition.—The time of life in a woman when the functions of the uterus and ovaries cease, menstruation terminating, — a period when disease of these organs is especially prone to occur, and when various constitutional disturbances are almost certain to arise.

Anatomical Characters.—Great changes occur in the sexual organs—the ovaries lose their smooth outline, and after a while become shrivelled up, occasionally only a trace of them remaining; the Fallopian tubes diminish in size, and sometimes become obliterated; the walls of the uterus atrophy, its cavity becomes much smaller, and the cervix disappears altogether.

Symptoms. — The term 'change of life' is used among women very widely to signify everything which affects them at this critical time. It is so rare for the transition from activity to inactivity to take place without some disturbance locally, or constitutionally, that women are apt to neglect seeking advice for symptoms which should demand careful treatment, believing as they do that it is natural to suffer in such ways at 'the change.' There is no fixed period for the climacteric epoch, though roughly it may be said to occur between the ages of forty-five and fifty. Certain causes are apt to determine the time—amongst these are parturition and lactation, febrile attacks, such as typhus or acute rheumatism, profuse hæmorrhages, fright, &c.

The symptoms vary much. In some women the change is abrupt, menstruation ceasing all at once after perfect regularity; in others, and more frequently, the change is prolonged, the catamenia being irregular for many months, and varying as to periodicity and quantity. Frequently, after a long interval, a profuse flow with clots occurs, and this is very often attributed to a miscarriage. This loss is frequently beneficial, and if it do not take place, or relief be derived from vicarious discharges, such as bleedings from hæmorrhoids, the excess of blood gives rise to headaches, flushes, vertigo, and a host of other unpleasant symptoms. The

balance between the nervous and circulatory systems is upset; irritability of temper, hypersensitiveness and all sorts of fancies arise, or depression sometimes amounting to melancholia ensues. If germs of disease exist, the uterus is especially prone at such time to develop them, so that carcinoma, fibroid disease, and polypus frequently present their first symptoms at this epoch. The importance, therefore, of an early examination cannot be too forcibly dwelt on, or the mischief of delay from considering the abnormal condition as typical of 'the change of life,' as a natural consequence, which will therefore right itself. At these times pruritus of the vulva, vascular growths at the orifice of the urethra, and cutaneous eruptions are especially likely to occur. There is a tendency to grow fat, and become coarse; frequently hairs appear on the face. The breasts often become very large and pendulous, and this with the increase in the size of the abdomen from flatus, and the deposition of fat in its walls, together with the cessation of menstruation, not infrequently gives rise to the supposition of pregnancy. To this imaginary state the term *Pseudocyesis* has been applied, and it is often almost impossible to set aside the opinion of the woman regarding her supposed condition. The headaches, neuralgia, loss of memory and nervous symptoms appear to be due to disturbance in the ganglionic system of nerves, with which the uterus and ovaries are largely supplied. If insanity arise the most common form it assumes is hypochondriasis or melancholia.

Treatment.—This must be directed to regulating the secretions. Generally constipation, previously troublesome, becomes aggravated; and portal congestion frequently occurs. Saline purgatives are especially beneficial, and these may be judiciously administered in the form of mineral waters, such as the Hunyadi Jànos, or Friedrichshall. Blue pill with aloes is often very useful. The headaches and reflex nervous symptoms may be best combated by the administration of bromide of potassium, and this drug appears to act as a direct sedative to the sexual organs, besides diminishing the amount of blood determined to them. Occasionally, bleeding from the arm or cupping gives great relief. Attention must above all be paid to the diet. It should be plain and unstimulating; beer and spirits should be prohibited, and only light wines, if any, allowed. Tepid baths are useful. Late hours, heated rooms, and excitement of all kinds should be avoided. If local troubles arise, they must be treated according to their indications; as a rule, abstracting blood from the uterus does harm, but leeches to the anus are sometimes beneficial. It is clearly impossible to map out any empirical line of treatment for a condition in which the symptoms are so variable. Clement Godson.

CHAPPED NIPPLES. *See* Breast, Diseases of; and Nipple, Diseases of.

CHAPS.—Synon.: Rhagades.—Cracks or fissures of the skin occur where the integument has become hardened by infiltration, as in the erythema of the hands and wrists of cold weather, in chronic eczema, psoriasis and lepra vulgaris. The *treatment* for chaps consists in protection from the atmosphere; careful drying after the hands have been washed or wetted; and the use of zinc ointment and glycerine soap. Diluted glycerine, vaseline, and cold cream are also popular remedies. Erasmus Wilson.

CHELOID (χηλή, a claw).—Synon.: Cheloides, Cheloma; Fr. *Dartre de la graisse*; Ger. *Keloid.*

Definition.—A tumour of the skin resulting from over-growth of connective tissue within the corium.

Ætiology.—Cheloma may be idiopathic or accidental, and in both cases it is referrible to a diathesis. When of accidental origin it is commonly associated with a cicatrix, and is then developed in the midst of the cicatrix-tissue. This form of the tumour has been denominated *cheloides spuria* or *traumatica*, and, as such, has been seen scattered numerously over the chest and shoulders as a sequel of acne.

The cause of cheloma must be sought for in that vital source from which is derived aberration of nutrition in general. It is a consequence of feeble controlling power, and may be resident in the skin alone, or be dependent on a want of vigour of the constitution of the individual.

The traumatic cheloid may follow a light as well as a severe injury of the skin, such as a boil, a blister, a leech-bite, or even the irritation of a stimulating liniment; it is sometimes met with in the scars of strumous abscesses or ulcers, but is most common in the cicatrices of burns or scalds.

Anatomical Characters.—At its first development cheloma occupies the fibrous portion of the corium. As it increases in bulk it pushes the vascular layer outwards and stretches the corpus papillare, obliterating the capillary network, more or less completely. In its aggregate form when it presents itself as a flat plate, raised for a quarter of an inch above the level of the adjoining skin and sinking to a similar extent into the corium, it has the appearance of being tied down by strong cords or roots at either end, and frequently overlaps the healthy skin along its borders. In this state it is seen to be composed of strong fibrous bands closely interlaced with each other and enveloped by a smooth transparent pinkish layer, in which may be detected a scanty vascular plexus converging to venules which sink between the meshes of the fibrous structure.

Around the circumference of one of these larger flattened tumours, such as is commonly met with on the sternum, and measuring several inches in diameter, there will generally be observed a few scattered knots. These are developed in the fibrous sheath of the arteries at a short distance from the mass, and, being thus linked to the central growth, are subsequently drawn into the focus of the tumour. And the development of the so-called roots is explained by the propagation of the proliferating process by the coats and sheaths of the blood-vessels communicating with the central tumour.

Description.—Cheloid has received its name from its habit of throwing out spurs from its circumference, these spurs having been compared to crab's claws. It originates in a round

oval, or oblong tubercle or knot in the skin, and this may be followed by a second in its immediate neighbourhood, or sometimes by a cluster of three or four. When two of these knots are situated at a short distance apart they are apt to become connected by a cord of the same structure as themselves, and to give rise to what has been called a *cylindrical*, *club-shaped*, or *dumb-bell* cheloid. When three or four knots are grouped near together they are disposed to become blended by growth and produce an oval or square-shaped cheloid; and when the growth extends from these latter into the surrounding integument the appearance denominated *radiciformis* is established. Cheloma being due to a tendency to overgrowth or hyperplasia of connective tissue within the skin, it may appear on several parts of the integument at the same time, one of the most common seats of its development being the sternum, which it generally crosses transversely. It is often solitary; is more commonly composed of five or six tumours, discrete or confluent; but has been met with occasionally to the number of fifty or sixty tubercles or more.

Course and Prognosis.—Cheloid rarely gives rise to much inconvenience or attains any considerable magnitude, and when left to itself progresses very slowly or remains stationary for a number of years or for life; and we have known it to disappear spontaneously. Its subjective symptoms are of no great severity, being limited to itching, tingling, and smarting, and more or less uneasiness in moving the limbs, or from pressure when sitting or lying in bed. It has no tendency to desquamation or ulceration.

Treatment.—Being dependent on a diathesis, surgical manipulation has generally proved unavailing in cheloma. It might be expected to recur in the cicatrix of a wound made for its removal, or in the scars of a suture employed to hold the cut edges together, and such has proved to be the case. The most successful treatment consists in covering up the tumour with a mercurial or iodine plaster, or even with simple emplastrum plumbi. The writer's favourite treatment is to paint it with a spirituous solution of soap and iodide of potassium, and then cover it with an adhesive plaster spread on washleather, repeating the application as often as the plaster becomes loosened. We have seen a multiple cheloma cured in this way; aided by mild doses of the perchloride of mercury. The combination of warmth and moisture, such as is produced by a plaster, is an important element in the cure. But irritants, caustics, and the knife are all equally objectionable and valueless.

Erasmus Wilson.

CHELTENHAM, in Gloucestershire. Common salt waters. *See* Mineral Waters.

CHEMOSIS (χήμη, a hole).—A swollen condition of the conjunctiva, caused by effusion into its tissue around the cornea, which thus appears as if placed in a hole or hollow. *See* Eye and its Appendages, Diseases of.

CHEST, Diseases of the.—Following the plan adopted in the general article on the Abdomen, it is proposed in the first place to give an outline of the diseases of the chest; and then to indicate the principal points bearing on their clinical investigation.

General Summary. — The diseases of the thorax and its contents may be conveniently divided into certain groups, namely:—

I. Diseases of the chest-walls, or extending inwards from these walls.

II. Diseases of the respiratory apparatus contained within the thorax, namely:—1. Pleuræ. 2. Trachea. 3. Main Bronchi. 4. Lungs.

III. Diseases connected with the circulatory system, including:—1. Pericardium. 2. Heart. 3. Great vessels within the chest, both arteries and veins.

IV. Diseases originating in the mediastinal cellular tissue.

V. Diseases of the absorbent vessels or glands within the chest; of the thoracic duct; and of the thymus gland or its remains.

VI. Diseases of the œsophagus.

VII. Diseases of either of the important nerves traversing the chest.

VIII. Diseases of the diaphragm.

IX. Diseases encroaching upon the chest from the abdomen or from the neck.

The particular diseases comprehended within most of the groups just enumerated are very numerous, and they will be described under their respective articles. Affections connected with the chest constitute a large proportion of the cases which come under observation in practice. This will be readily understood when we remember that the thorax encloses organs essential to life, which are never at rest, and which are constantly more or less exposed to influences liable to injure them. They may be mere *functional disorders*, and to these the heart is especially prone; but serious *organic diseases* are also exceedingly common, and rank very high as causes of death. Moreover, they may either come under the category of *local* affections, though even then they frequently depend upon some cause acting through the general system, such as exposure to cold or wet; or they arise in the course of some *general* malady. For instance, pulmonary complications are of common occurrence in connexion with fevers and various other diseases; the heart is implicated in a large proportion of cases of rheumatic fever; and malignant disease is not infrequently manifested by a local development of cancer in connexion with certain of the thoracic contents. The structures within the chest have an important mutual influence upon each other; and they may also be affected, either directly or indirectly, by local diseases involving other parts of the body, such as the abdomen or the central nervous system.

Clinical Investigation.—It may be confidently affirmed, that the means which we now possess for investigating diseases connected with the chest are so adequate and precise, that any one possessing the requisite knowledge and skill, and who carries out the clinical examination properly, can, in the very large majority of cases, arrive at a diagnosis with certainty and accuracy. At the same time it must be remembered that every complaint referred to this region, however trivial it may appear to be, does require system-

atic and thorough investigation, otherwise very serious mistakes are constantly liable to be made. Of course, cases also do come under observation occasionally which are obscure, and which may call for repeated examination before a correct diagnosis can be formed; and exceptional instances occur in which no satisfactory conclusion can be arrived at. The previous general history of the patient, the hereditary history, and the account of the origin and progress of the illness, often afford signal aid in the investigation of chest-affections, and ought never to be overlooked. The symptoms to which these affections give rise are necessarily various. Pain or other morbid sensations are very commonly complained of, but only in a comparatively few instances are these at all significant, and they can never be positively relied upon in making a diagnosis, while they are often absent in diseases of the most serious character. The important organs, namely, the lungs and heart, usually present more or less disturbance of their functions when they are affected, but grave diseases may exist without any such disturbance. The different structures within the chest have a mutual influence upon each other, and thus other symptoms besides those connected with the structure actually diseased may be apparent. For instance, the lungs and heart are thus very intimately associated; while aneurisms or growths often disturb these organs seriously, or interfere with the air-tubes, nerves, veins, and other structures. In consequence of more or less interference with the circulation, various symptoms in parts remote from the chest are frequently originated; and distant organs may become the seat of organic lesions as the result of long-continued mechanical congestion, a new train of symptoms being thus set up. The general system may be in this manner affected; whilst pyrexia, wasting, and other general symptoms are often associated with chest-diseases. Lastly, morbid conditions within the thorax may directly affect the abdominal organs; or may make their way through the diaphragm into the abdominal cavity.

Physical Examination constitutes an essential and most important part of the clinical investigation of the chest and its contents. Indeed, without this examination no certain and exact diagnosis can ever be made. This subject is fully discussed in other appropriate articles, and here it need only be mentioned that the methods of examination which are usually required, and which should in every case be practised, are:—1. *Inspection.* 2. *Palpation.* 3. *Percussion.* 4. *Auscultation.* Other modes which may be called for include:—5. *Measurement* (not uncommonly). 6. *Succussion.* 7. The use of *special instruments*, directed to the investigation of particular organs, such as the spirometer, cardiograph, sphygmograph, aspirateur, œsophageal bougie, &c. *See* PHYSICAL EXAMINATION, and Diseases of the several organs. FREDERICK T. ROBERTS.

CHEST, Examination of. *See* PHYSICAL EXAMINATION.

CHEST-WALLS, Morbid Conditions of.—The walls of the chest may be the seat of various morbid conditions, and the affections of this portion of the framework of the body demand more attention than they are accustomed to receive. All that can be done within the limits of this article is to indicate their nature; to notice briefly such of them as are not described in other parts of this volume; and to point out the principles of treatment. They may be considered according to the following arrangement:—

1. **Superficial Affections.**—Under this group may be included morbid conditions of the skin and subcutaneous tissues. *a.* Cutaneous eruptions are of common occurrence over the chest. Among these may be specially mentioned the eruptions of the exanthemata, herpes zoster, and chloasma. *b.* The superficial vessels are liable to become enlarged under certain circumstances. This enlargement is usually seen in the veins over the front of the thorax, which may be distended on both sides, or only on one side, or in some particular region. The larger divisions may alone appear to be involved; or a more or less extensive network of smaller veins may be visible, and occasionally even the capillaries seem to be implicated. This condition generally arises from some obstruction interfering with the circulation through one or other of the principal veins which, either directly or indirectly, receive the blood from the veins of the thoracic wall. Thus the superior vena cava, or either innominate, subclavian, or axillary may be implicated, being, for example, pressed upon by new growths or enlarged glands, the distribution and extent of the venous distension varying accordingly. Occasionally one of the smaller veins is thus interfered with. The writer has met with cases in which considerable enlargement of the veins was visible over portions of the thorax, where the cause was by no means evident, the patients asserting that this condition had existed ever since they could remember, and being regarded by them as perfectly normal. Probably it has resulted from some local obstruction occurring during early life. It must be remembered that women who are suckling frequently present great enlargement of the superficial veins over the front of the chest, which usually subsides when the period of lactation is at an end. Again, more or less venous and capillary engorgement in this region may occasionally be observed in cases of cardiac or pulmonary disease, where the general circulation is much impeded, and due aëration of the blood is interfered with. Sometimes a ring of enlarged veins and capillaries is seen around the lower part of the chest. When the venous distension is due to obstruction of the vena cava superior, the skin may present a more or less marked cyanotic tint, and in cases of general cyanosis, the chest, in common with other parts, has a cyanotic appearance. Occasionally one or other of the small arteries which supply the thoracic walls is enlarged, and it may attain a considerable size. *c.* Subcutaneous œdema is sometimes observed over the chest. In most instances this is a local condition, being the result of venous obstruction; but it may be a part of general dropsy, particularly in connexion with renal disease. This morbid state is evident on inspection or to the touch, and the affected part pits on pressure. *d.* The subcutaneous tissue of the thorax is also liable to become the seat of

so called emphysema, as the result of perforation or rupture of the lung and pleura, with the consequent escape of air into the cellular tissue under the skin, where it accumulates, and travels to a greater or less extent over the body. The lung may also give way into the mediastinum, the air which escapes subsequently making its way from this part into the subcutaneous tissue. This condition is generally due to direct injury, especially from fractured ribs, but it may also arise, in exceptional instances, from other causes, such as violent cough, powerful expiratory efforts, as in parturition, pulmonary disease—for instance, the giving way of a cavity in the lung—or in connexion with empyæma. Subcutaneous emphysema is attended with evident swelling of the part, which may be very great, all the normal anatomical outlines being obliterated; the peculiar sensation accompanying this condition is readily elicited on palpation and percussion; the percussion sound is tympanitic; and on auscultation a superficial crackling sound is heard. *e.* As belonging to the superficial affections connected with the chest may be just mentioned diseases of the mammary gland or nipple, which of course constitute a most important class of diseases in females (*see* BREAST, Diseases of).

2. **Muscular and Tendinous Affections.**—*a.* The muscles of the chest or their tendinous attachments may be the seat of certain painful affections. These are of the nature of so-called muscular rheumatism or myalgia, of inflammation, or of more or less injury or strain; being induced by cold, constitutional conditions such as gout, overwork, straining, violent coughing, fatigue from prolonged sitting, and other causes. The painful condition is usually localized, but different muscles are involved in different cases, sometimes those which are superficial being affected, in others the deeper muscles including the intercostals; or the complaint may be confined to a single muscle. Pleurodynia, dorsodynia, and scapulodynia are the terms applied to muscular rheumatism affecting the side of the chest, the upper part of the back, and the scapular regions respectively. As the result of severe coughing, muscular pains are very common around the lower part of the chest. The pain is usually more or less aching in character, and not severe, but it may be very intense, especially in acute cases. Whatever brings the affected muscles into play aggravates the suffering, such as moving the arms or shoulders when the superficial muscles are affected, coughing, sneezing, and similar actions. In some instances the pain is not felt when the affected structures are kept quite at rest. There may be local tenderness on pressure, or diffused pressure may give relief; while posture often influences the sensations experienced, such as whether the patient assumes the recumbent or sitting posture, or lies on one or other side. Fatigue generally increases the pain. Muscular affections connected with the chest are not necessarily accompanied with any other local symptoms; and physical examination reveals nothing, except that perhaps the act of breathing is voluntarily restrained, on account of the pain thus induced. *b.* The muscles of the chest may be affected, on the one hand, with spasm or cramp; on the other, with paralysis. The former is attended with more or less pain, which may be very severe; the latter is indicated by loss of power in the muscles involved. These disorders generally depend on some lesion of the central nervous system, but may result from local nerve-disease. In cases of hemiplegia from cerebral mischief, the muscles of the thorax on the affected side are often temporarily weakened, but they usually subsequently regain their power. When the upper part of the spinal cord is injured or diseased at a certain point, all the muscles of the chest become paralysed, which is a very serious matter, as respiration and the acts connected therewith cannot be carried on, except by the diaphragm, and consequently the blood is imperfectly aërated, secretions accumulate in the lungs, and the patient dies from suffocation. *c.* Atrophy or degeneration may involve the thoracic muscles. In cases of pulmonary phthisis either the whole of these muscles or certain of them are not uncommonly wasted out of proportion to the general emaciation. These muscles may also be more or less implicated in progressive muscular atrophy, and occasionally a single muscle undergoes marked wasting. The writer has seen a striking example of this local atrophy in connection with the pectoralis major, but the serratus magnus or other muscles may be implicated. The wasting is probably in most cases due to disease of the nerves supplying the affected muscles. It is quite evident on examination, and the movements which are usually performed by the involved structures cannot be executed properly. *d.* On the other hand, the chest-muscles may become hypertrophied. This may be a natural result of training; or it may occur in consequence of their being called upon, either habitually or at intervals, to act excessively, as in cases of emphysema or asthma. In exceptional instances the condition known as pseudo-hypertrophic muscular paralysis has extended up to the chest. *e.* The thoracic muscles occasionally present marked irritability under percussion or friction. This has been regarded as an important sign of phthisis; but the writer has only observed it in a comparatively few instances of this disease, and has found it equally if not more evident in cases where the lungs were perfectly healthy. *f.* As the result of injury and other causes, some portion of the muscular structures of the chest may be lacerated, ruptured, or perforated, either alone or along with other structures. This condition will be further alluded to presently.

3. **Nervous Affections.**—*a.* Neuralgia is very common in different parts of the chest, especially in the side, and particularly the left side—*intercostal neuralgia*. The pain is localised, being usually referred to a point where a branch of nerve becomes superficial. It is more or less constant, but subject to exacerbations, in some cases being very severe at times. It may be increased by deep breathing or coughing, but is not, as a rule, so much affected by these and similar actions as are other painful chest-affections. Shooting and darting sensations often radiate from the principal point, and certain spots of tenderness—*points douloureux*—may be recognised in many cases (*see* INTERCOSTAL

Neuralgia). *b.* Intercostal neuritis is occasionally met with, and this affection is attended with great pain, localised and radiating, with much tenderness, the suffering being aggravated by whatever causes any local disturbance. It is probable that the severe pains experienced in some instances where the complaint is supposed to be muscular, are due to branches of nerve being in an inflammatory condition. *c.* Some individuals, especially females, exhibit a remarkable superficial tenderness over the thorax or in parts of this region, especially the anterior and upper portions. The slightest touch is resented, and the most delicate percussion cannot be borne. This condition may exist without any actual disease, or it is sometimes observed in phthisical cases. *d.* Sensation may be more or less impaired over the chest, or in limited portions, either in connexion with central or local nervous disease, or in hysterical and nervous persons. Various paræsthesiæ are also frequently referred to this region by the class of individuals just mentioned.

4. **Diseases of the Bones or Cartilages.**—The morbid conditions which may be referred to the bony and cartilaginous framework of the thorax are as follows:—*a.* There may be undue rigidity and firmness of the chest-walls, owing to an excessive deposit of calcareous matter in the sternum and ribs, with ossification or petrifaction of the cartilages. This is a normal condition in old people, being one of the degenerative changes to which they are liable, but it may also occur in younger individuals, as the result of hard work, or in connexion with certain pulmonary diseases. This state of rigidity interferes more or less with the respiratory movements, and not infrequently causes serious embarrassment. *b.* On the other hand, the ribs and cartilages may be deficient in firmness, and consequently too yielding and elastic. This is observed in children and young persons who are ill-nourished, and it becomes a condition of great moment when any disease sets in which causes obstruction to the entrance of air into the lungs, such as bronchitis. The chest-walls are then liable to fall in more or less during the act of inspiration, and may become permanently deformed, the pigeon-breast and other abnormal forms of thorax being thus originated. In rickety children the vicinity of the junction of the ribs with their cartilages is the most yielding part of the chest, where nodular thickenings may often be felt, and in such subjects this is the portion of the thoracic wall which is most liable to fall in. *c.* Acute or chronic periostitis or perichondritis is sometimes observed in connexion, respectively, with the sternum or ribs, or with the cartilages. The acute affection gives rise to much pain and tenderness, which may be accompanied with superficial redness and swelling, and may simulate some more serious disease. The chronic complaint usually assumes the form of a node, being the result of syphilis. The writer has occasionally observed a small swelling at the junction of one of the ribs with its cartilage, painless, unaccompanied with redness, but presenting distinct fluctuation. *d.* The bony and cartilaginous structures themselves may be the seat of disease in some part of the chest, and here must be included the portion of the spinal column which limits this region posteriorly. Thus there may be acute inflammation, caries, necrosis, or so-called scrofulous disease. Among the more important causes which are liable to originate these conditions may be mentioned injury, syphilis, scrofula, empyæma opening externally, and thoracic tumours or aneurisms growing outwards. They may lead to serious consequences, both local and general, and frequently cause more or less deformity of the chest. *e.* Permanent thickening and distortion of portions of the ribs are sometimes observed after fractures which have united improperly.

5. **Inflammation and Abscess.**—It is expedient to make a separate group of those cases in which inflammation, resulting in the formation of one or more abscesses, occurs in some portion of the soft structures entering into the construction of the chest-walls. This may be of local origin, arising from injury, bone-disease, or other causes; or it may be due to the opening of an empyæma into the tissues; to suppuration extending and burrowing from the axilla or other parts; or to pyæmia. If deep-seated, an abscess may be difficult to detect with certainty, but usually the signs of this condition become sufficiently obvious. Sinuses or fistulæ may be left as a consequence of suppuration in the chest-wall, especially when pus makes its way outwards from within.

6. **Tumours and New-Growths.**—These morbid conditions also demand separate notice. They may be connected with any of the structures of the chest-walls, and are of various kinds; among those which have come under the writer's notice may be mentioned molluscum, fatty growths, cystic tumours, enlarged sebaceous glands, and infiltrated carcinoma. Tumours may make their way inwards from the chest-walls, encroaching upon the cavity of the thorax; or, on the other hand, the walls may be involved by growths from within. It need scarcely be mentioned that mammary tumours constitute a distinct, and by far the most important group associated with the structures covering the chest. *See* Breast, Diseases of.

7. **Perforations and Ruptures.**—The muscular structures of the thoracic wall may be more or less destroyed in some part either by sudden rupture or gradually, allowing a hernial protrusion of the lung to take place between the ribs. As already noticed, empyæma may make its way outwards through the chest-wall. Aneurisms and tumours extending outwards from within the thorax frequently cause serious destruction of the tissues, including the bony and cartilaginous, as well as the soft structures. This destructive process is often attended with severe pain and suffering, and leads to grave mischief.

8. **Variations in Form and Size.**—The chest often presents deviations from the normal shape and size, and these are so important that they demand separate consideration. *See* Deformities of Chest.

Treatment.—In many cases where the chest-walls are in a morbid state, they either do not need any special treatment, or no treatment can

be of avail. The chief circumstances under which the practitioner may be called upon to interfere, and the measures to be adopted, may be briefly indicated as follows:—

a. Painful affections of the chest-walls, depending upon conditions of the muscles or nerves, frequently demand local applications for their relief. Thus in different cases it may be requisite to employ hot fomentations, dry heat, or cold applications, in the form of wet rags frequently changed, ice, or evaporating lotions; or to use anodyne applications of various kinds, such as belladonna plaster or liniment, opium plaster or a liniment containing laudanum, oleate of morphia, tincture of aconite or ointment of aconitine, or veratria ointment. Anodynes may also sometimes be added to fomentations with advantage. Friction is often of much service, and at the same time stimulating liniments may be employed, such as one containing camphor, chloroform, or turpentine. For ill-defined muscular pains about the chest, which are frequently complained of, free douching with cold water every morning, followed by friction with a rough towel, is often highly efficacious. When pain is localised and obstinate, much benefit may be derived from the application of a sinapism, mustard-leaf, or even a small blister. In other cases the use of the ether-spray is serviceable, repeated more or less frequently; or sometimes much relief may be obtained from applying over a painful spot a mixture of equal parts of chloroform and belladonna liniment. Galvanism is another agent which may be of the greatest service in relieving painful sensations about the chest, whether connected with the muscles or nerves. Subcutaneous injections of hot water, morphia, or atropine may be demanded in some cases, and constitute a most valuable mode of treatment if pain cannot otherwise be assuaged.

In the treatment of many painful affections of the chest-walls much assistanse may be derived from attention to posture, especially in connection with certain occupations; from the avoidance of undue fatigue, or of any violent actions which are known to influence this part, such as cough; and from the adoption of measures tending to support the structures, or to keep them in a state of rest. The writer has found great benefit in a large number of instances from strapping the side more or less extensively, in the manner advocated by him for the treatment of pleurisy; and if there is any localised pain, some limited anodyne application, such as a piece of belladonna plaster, may be placed over this spot under the strapping.

b. In many affections of the chest-walls, treatment directed to the general system, or to some special constitutional condition, is often of the greatest service. Thus, in the painful complaints already noticed, there are frequently marked general debility and anæmia; and essential benefit is derived from the administration of quinine, preparations of iron, strychnine, cod-liver oil, preparations of phosphorus, and other tonic medicines, or such as improve nutrition. Some of these are also most useful when there is disease of bone and its consequences. Again, certain affections of the thoracic wall may be associated with rheumatism, gout, or syphilis, and then the particular treatment indicated for each of these several conditions is called for.

c. When disorders of the muscles of the chest-walls occur, such as paralysis or spasm, associated with some disease of the central nervous system, the treatment must usually be directed to this disease, and but little can be done for the local disturbance. In some instances, however, electrical or other modes of treatment may be of some service, by influencing the action of the muscles, but no definite rules can be laid down.

d. Local inflammations in connection with the thoracic walls must be treated as in other parts of the body, and it is unnecessary to discuss this subject in the present article.

e. Surgical treatment may be called for under certain circumstances. Of course this will be the case if the chest-walls are injured in any way. Among other conditions likely to demand surgical interference may be specially mentioned subcutaneous emphysema, abscesses, disease of the bones, and tumours.

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CHEST-WALLS, Deformities of. *See* DEFORMITIES OF CHEST.

CHICKEN-POX.—SYNON.: Varicella; Fr. *La Varicelle*; Ger. *Wasserpocken.*

DEFINITION.—A specific infectious febrile disease, characterised by the appearance, in successive crops, of red spots, which in the course of about a week pass through the stages of pimple, vesicle, and scab.

ÆTIOLOGY.—The origin of this disorder is unknown. It is certain that it arises from contagion, and that childhood is its predisposing cause. It occurs in children at the breast, and is seen with increased frequency up to the fourth year, at which period it attains its maximum. It is less often found between four and twelve, and after twelve it may be said to disappear, although it is occasionally seen in adults.

SYMPTOMS.—The illness commences without any, or with but slightly-marked premonitories. There is usually, however, some feeling of lassitude, and the patient goes to bed earlier than usual. Within a few hours an eruption appears, usually on some part of the back or chest, but there are many exceptions to this rule. It may commence on the face, neck, chest, abdomen, or extremities, or upon several of these parts at the same time. The eruption consists of small, faintly papular rose-spots, varying in number from twenty to one or two hundred. These, in the course of eight, twelve, or, at the most, twenty-four hours from their appearance, change into vesicles, which, at first small in size and clear as to their contents, become quickly large; globular, or semi-ovoid in form; translucent, glistening, and opalescent in appearance; and surrounded with a faint areola. Towards the end of the second day of illness, the vesicles attain complete development, and about this time a few may be seen on the sides of the tongue, on the lips, cheeks, or palate, and sometimes upon the mucous membrane of the genitals. About the third day a few of the vesicles may have a pustular appearance, and sometimes a few pustules are seen; but, regarding the eruption as a whole, pustulation forms an incident rather than an essential feature

in its progress. On the fourth day the vesicles begin to dry up, and by the sixth complete scabs are formed. These fall off in a few days, leaving in their place faintly red spots, and sometimes a few pits. A single crop of the eruption may be said to complete itself in five or six days; and, as two or three crops appear on as many successive days, the illness will last rather more than a week. In the event, however, of there being four or five crops, it may be prolonged for another week, but this is unusual. With the appearance of the eruption, the temperature rises two, three, or even more degrees, and this rise recurs with each successive crop of spots. The pulse is sometimes slightly increased in frequency; the tongue is moist, and sometimes covered with a light fur. As a rule, however, there is but little constitutional disturbance, although it is occasionally severe.

Pathology.—Chicken-pox is due to the reception of a specific poison, which after an incubation of about thirteen days, shows itself by an eruption upon the skin. What this poison is, how it enters the body, and what, if any, changes it produces upon the internal organs, the present state of our knowledge does not enable us to say. It affects the same individual once only, and it is perfectly distinct from modified small-pox, as the following considerations will show:—1. Chicken-pox is characterised by the *rapidity* with which it runs through its stages; modified small-pox, on the contrary, is characterised by an interruption in the course of the disease at one or other of three points—the papular, the vesicular, or the pustular. 2. The chicken-pox eruption attains complete development by the end of the third day; in modified small-pox, should the eruption attain complete development, this will not occur before the ninth day, however much the disease may be modified. 3. In modified small-pox the premonitory symptoms are usually well-marked, often quite as severe as in the natural disease, and these last forty-eight hours, after which there is an eruption of small hard papules on the forehead, face and wrists, followed by a *fall* of temperature. In chicken-pox the premonitories are most often wanting, and when present are slightly marked, and the eruption is followed by a *rise* in the temperature. It appears, moreover, upon any part of the body indiscriminately, and less frequently on the face than on other parts; and within a few hours—at the most within twenty-four—it has become vesicular; whereas in modified small-pox the vesicular stage is only reached forty-eight hours after the appearance of eruption. 4. The vesicles of chicken-pox are globular or ovoid in form, without any central depression; glistening or translucent in appearance; and unicellular in structure. They collapse on pricking, and attain their maximum development in from twelve to eighteen hours. Modified and natural small-pox vesicles are flat and circular in form, always depressed in the centre, and sometimes umbilicated, of an opaque dirty white colour, and multicellular in structure. They do not collapse on pricking, and attain their maximum development at the end of the third day from their origin. 5. Small-pox is an inoculable affection; chicken-pox, according to reliable authority, is not. 6. When cases arise which all recognise to be modified small-pox, they are always accompanied by others which are more severe; and in epidemics these latter gradually become more numerous up to a point of maximum intensity, when they decline and the modified forms reappear. In chicken-pox there is no such gradual increase in the intensity of illness, and neither serious nor fatal cases form part of its epidemics, which prevail independently of small-pox. 7. Small-pox and vaccinia are often early followed, in the same individual, say within two or three years, by chicken-pox, and *vice versâ*. 8. Chicken-pox, vaccinia, and small-pox have been known to follow in immediate succession in the same individual.

Course, Terminations, Sequelæ.—Varicella always runs a favourable course, invariably terminates in recovery, and has no sequelæ.

Diagnosis.—It should be borne in mind that a sure diagnosis cannot be made in less than forty-eight hours. The appearance, however, of a crop of vesicles, followed on the next day by a second crop, points almost certainly to chicken-pox. Attention to this, and to the points noted under the head of pathology, ought to make the diagnosis easy.

Prognosis.—This, as has been indicated above, is always favourable.

Treatment.—The treatment of chicken-pox consists in confining the patient to his room, or in the more marked cases to his bed, for one or two days; and in the administration of light, unstimulating food. Although no physician has recorded a fatal case of chicken-pox, a child whose temperature may be three, four, or six degrees above the normal, should be watched with care. Alex. Collie.

CHIGOE.—Description.—The Chigoe is a minute parasitic insect, common in the West Indies and northern parts of South America. It is also popularly known as the *Jigger* or *Sandflea*. Though formerly regarded as an acarus or mite, it is now generally recognised as a true flea belonging to the genus Pulex (*P. penetrans*); but several entomologists have advanced solid reasons for separating it from the ordinary fleas. Thus Westwood terms it the flesh-flea, or *Sarcopsylla penetrans*, whilst Guérin formed the genus *Dermatophilus* for its reception. Practically, these distinctions are of little moment.

The Chigoe ordinarily lives in dry and sandy situations, where it multiplies to a prodigious extent. It attacks, however, the feet, chiefly underneath the nails and between the toes; the impregnated females burying themselves beneath the skin. Here the abdomen of the parasite swells to the size of a pea; and, unless removed by operation, gives rise to acute local inflammation, terminating in suppuration and sometimes in extensive ulceration, with even fatal results to the patient. Dogs also suffer excruciating torment from the bites and immigration of the *Bicho do Cachorro*, which, however Pohl and Kollar regard as distinct from the human jigger (*Bicho de pé*). Be that view correct or not, it would appear from the observations of Rodschild and Westwood that the larvæ of the human chigoe are hatched in the open wounds or ulcers, which sometimes extend inwards so as to involve the bones

themselves. In bad cases amputation of the toes and adjacent parts becomes necessary. Left to themselves, the larvæ escape from their host, and probably, after the manner of bots and other parasitic insects, penetrate the soil for the purpose of acquiring the pupal stage of growth.

Treatment.—As regards treatment, the indications are simple. The parasite should be removed with the utmost care. Where this has not been done, and where, as a consequence, open sores exist, frequent washings with tepid water, followed by the application of carbolic acid lotions (twenty or thirty grains to the ounce), or of ointments (one drachm to one ounce of benzoated lard) will be found most suitable. Or, again, the carbolic acid putty, as sold in shops, or the application of one part of the acid previously mixed with ten or twelve parts of simple olive oil, will, in all likelihood, be sufficient to cause the destruction of any larvæ that might remain. In European practice cases of jigger are rarely seen; nevertheless the writer has recorded an instance in which strong mental delusions followed the torture produced by these creatures (*Worms*, p. 141). The patient, a middle-aged married lady, had suffered severely during her residence in the West Indies. Although she had got rid of the parasites, she constantly harpooned her own feet in the hope of destroying the young jiggers which she felt sure were still burrowing beneath the skin. Lastly, it seems almost needless to say that residents and travellers in Guiana, Brazil, and in the West Indies generally, should have their feet properly protected. T. S. Cobbold.

CHILBLAIN.—Synon.: Kibe; *Pernio*; Fr. *Engelure*; Ger. *Frostbeule.*

Definition.—A state of inflammation of a part of the skin induced by cold.

Ætiology.—Chilblains are common in children and young persons, and are more frequent in girls than in boys. They occur chiefly in those of a lymphatic constitution, and may be considered as an indication of debility and deficient vital power. In adult age they are rare, and are only met with when the powers of the constitution are reduced. Their occurrence is influenced more by the strength of the individual than by the degree of cold, and they continue in some persons throughout the entire year. Their tendency is to cease with the full development of the organism, and they reappear occasionally in advanced life.

Description.—The regions of the body usually affected with chilblain are the feet and hands, to which are sometimes added the ears and nose. A chilblain presents three stages or degrees of severity, namely, *erythematous*, *bullous*, and *gangrenous*; and it may be arrested at the first or second stage by the withdrawal of the cause. The *erythematous* stage is restricted to hyperæmia, swelling, and severe burning and itching, the itching being increased by heat, as by that of the fire or that induced by exercise. The congested spot is circular in figure, somewhat tumid, brightly red at first, but later on roseate crimson, purple, or livid in colour. The second or *bullous* stage exhibits the blain or blister resulting from effusion of serum beneath the cuticle; the permanent colour of the swelling is now purple or livid, and the contents of the blister a limpid serum, generally reddened with blood; sometimes, indeed, the fluid of the blister may be semi-purulent. In the *gangrenous* stage the blister is broken, the surface of the derma is in a state of gangrene, and the gangrenous layer is subsequently removed as a slough by ulceration.

Treatment.—The treatment of chilblain requires to be modified to suit its different degrees. In the first, the indication is to restore normal circulation by gentle friction, and, when the part is severely chilled, it is usual to rub it with snow; then some soothing liniment may be employed; and, finally, a stimulating liniment, covering the part afterwards with zinc ointment and cotton wool, or shielding it with lead or opium plaster spread on washleather. The liniments most in favour for this purpose are the soap liniment with chloroform, the compound camphor liniment, the turpentine liniment, and the linimentum iodi. In the bullous stage a similar treatment may be used to the erythematous portions, whilst the blister should be snipped and the broken surface pencilled with the compound tincture of benzoin, and afterwards dressed with unguentum resinæ or an ointment of Peruvian balsam. In the third stage the erythematous phenomena still require attention, and the ulcer should be dressed with unguentum resinæ, either alone, or in combination with spirits of turpentine.

To obviate constitutional debility, the diet should be nutritious and generous, and recourse may be had to tonic remedies, such as iron and quinine. Erasmus Wilson.

CHILL. — A subjective sensation of coldness, accompanied with shivering, and most frequently experienced in connexion with febrile or inflammatory diseases, in nervous individuals, and after exposure to cold and wet. In popular language 'taking a chill' is used as synonymous with 'catching a cold.' *See* Rigor.

CHIN-COUGH.—A synonym for whooping-cough. *See* Whooping Cough.

CHIRAGRA (χείρ, the hand, and ἄγρα, a seizure).—Gout in the hand. *See* Gout.

CHLOASMA (χλόα, a green herb).—Synon.: Liverspot. Fr. *Ephelide*; Ger. *Leberfleck.*

A pigmentary discolouration of the skin, of a yellowish brown or liver-colour tint, occurring in blotches, and due to constitutional causes. Its synonym, *ephelis gravidarum*, indicates its occasional association with pregnancy. *See* Pigmentary Skin Diseases.

Erasmus Wilson.

CHLORAL, Poisoning by. *See* Antidote.

CHLOROFORM, Use of. *See* Anæsthetics.

CHLOROSIS (χλωρός, green or sallow). Synon.: Green-sickness; Fr. *La chlorose*; Ger. *Chlorose; Bleichsucht.*

Definition.—A variety of anæmia occurring in a peculiar diathesis or habit of body, which is characterised by deficient growth of the corpuscular elements of the blood, and of the vascular system.

The subjects of this diathesis are said to be *chlorotic*. They ordinarily enjoy good health, unless exposed to any of the causes of anæmia, when they speedily suffer from aglobulism; and this aglobulism may proceed to complete anæmia. The term *chlorosis* is properly applied to the first and simpler form of anæmia in these subjects; while the second and more complex condition is designated *chlor-anæmia*; or, more commonly, *anæmia* (*see* ANÆMIA).

ÆTIOLOGY.—Chlorosis occurs almost without exception in young women about the time of puberty, but is found occasionally in children and married women, and, very rarely, even in men. It is believed to be more common in the higher ranks of life. Beyond these predisposing causes, however, the very origin of the disease lies in a peculiar condition of the blood and blood-vessels, to be presently described, which is believed to be congenital, and perhaps hereditary. In such subjects, and under the preceding circumstances, any of the numerous causes of anæmia may be sufficient to excite the appearance of chlorotic symptoms, but those which do so most commonly are sexual development, the establishment of menstruation and its disorders, and an insufficient supply of light to the circulating blood.

ANATOMICAL AND CHEMICAL CHARACTERS.—The blood in chlorosis presents three definite and distinct imperfections. First, the total quantity of blood is below the normal, though there may be an excess in relation to the calibre of the vessels (*plethora ad vasa*). Secondly, both red and white corpuscles are deficient in numbers, and that proportionately. Thirdly, the individual red corpuscle contains less than the normal amount of hæmoglobin, and this deficiency may be so great that the total amount of hæmoglobin in the blood is reduced to one-fourth. It is an important negative fact that in pure chlorosis the quality of the liquor sanguinis is unchanged.

With this condition of blood there are associated remarkable abnormalities of the aorta and arterial system generally. The most striking of these is a hypoplasia, or dwarfed condition of the aorta, represented by small calibre, increased elasticity, anomalous origin of the branches, and unequal thickness of the intima. Along with these there may be found—probably as a consequence of the preceding—fatty metamorphosis of the intima, and enlargement of the heart, with traces of endocarditis. The blood-glands and lymphatic structures are not diseased. The condition of the ovaries and uterus has been carefully examined in chlorosis and found to vary extremely. In some cases the generative organs are described as 'infantile,' while in others they are either immoderately developed, or perfectly normal in every respect. Corresponding with the aglobulism, the subcutaneous fat is abundant; and the viscera present various degrees of fatty metamorphosis. When the cardio-vascular changes are marked and advanced, there may be extensive secondary disease throughout the body.

SYMPTOMS.—The symptoms of simple chlorosis are those of mild anæmia, with certain important differences, which become fewer and less marked and finally disappear as chlorosis advances to the more serious disease. The appearance of the chlorotic girl is peculiar, inasmuch as the pallor of her complexion is accompanied by natural or even increased fulness, from the excess of subcutaneous fat. At the same time the colour of the skin is so remarkable as to have given the name to the disease, the general hue being decidedly yellow. In blondes the transparency of the skin is increased; in brunettes it is diminished, and a dull yellowish-grey colour of skin is the result, which, in contrast with the greyish-blue of the eyelids, may appear of a sickly green.

The patient's usual complaint is of this alteration of colour, menstrual disorder, debility, great breathlessness, cardiac symptoms, and various pains. The menstrual symptoms are always prominent, namely amenorrhœa or menorrhagia, and leucorrhœa. Breathlessness on exertion is one of the most striking symptoms. The cardiac symptoms and the cardiac and vascular signs closely resemble those of anæmia. But there is this important difference in the phenomena connected with the heart, that in many cases of chlorosis they indicate enlargement, and especially hypertrophy of the left ventricle. The digestive and nervous systems are frequently very seriously deranged. The urine is abundant, watery, and pale. There is no dropsy in simple, uncomplicated chlorosis. Optic neuritis may occur.

The *chlorotic diathesis* may be recognized by the following characters, which are variously associated in different cases:—Diminutive stature; imperfect sexual development; a history of peculiar anæmia in childhood, of anæmia with menstrual irregularity at puberty, and of previous attacks of symptoms of chlorosis; evidence of cardiac enlargement or mitral disease in the absence of all the ordinary causes of these; the occurrence of endocarditis during pregnancy or *post partum*; and the presence of any of the diseases which will be referred to under the head of *complications*.

COURSE, DURATION, AND TERMINATIONS.—The commencement of chlorosis is generally gradual, but may be sudden. Its ordinary course is towards confirmed anæmia, in which it may terminate, the liquor sanguinis becoming affected, and wasting and œdema being added to the previous symptoms, which are also aggravated. It is for this reason that pure chlorosis is a rare disease, while anæmia associated with the chlorotic diathesis is comparatively common.—The duration of the disease is variable; it rarely declines until the determining circumstances have been removed, and the patient subjected to careful treatment. Chlorosis may reappear in the subject of the diathesis, and that more than once; but the probability of its return is small after the age of 25, especially in the married female. Death from chlorosis directly is excessively rare.

COMPLICATIONS AND SEQUELÆ.—According to Virchow, serious valvular disease and cardiac enlargement may be traced in some of the worst cases of chlorosis to the associated vascular condition; and the mitral valve is peculiarly liable to be attacked by endocarditis in rheumatic,

puerperal, or septic fever. Hæmorrhages, gastric ulcer, and exophthalmic goitre are believed to occur with comparative frequency in persons of the chlorotic diathesis.

Pathology.—The deficiency of the blood in red and white corpuscles, and of the individual red corpuscle in hæmoglobin, described above, indicates an imperfect production of the cellular elements of the blood, and imperfect growth of the red corpuscles. With this blood-state there is undoubtedly associated a hypoplastic or dwarfish condition of the blood-vessels. In the embryo the blood and blood-vessels are developed from the same elements, the former making its appearance within the cells which produce the latter. It is highly probable, therefore, that the anomaly of blood and the anomaly of vessels are to be considered as together an expression of some congenital defect of the blood-vascular system, leading to imperfect growth both of blood and of vessels. Any individual possessing a blood-vascular system thus anomalous labours under a peculiar diathesis, or debility of the corpuscles and circulatory system, and is said to be a *chlorotic* subject.

If the other systems of the body are full-sized (which is not always the case) the dwarfish condition of the arteries of the chlorotic subject, and the scanty supply of hæmoglobin, will tend to fail to supply the ordinary demands for blood, and especially for oxygen; and at every period of extraordinary demand within the economy the blood-vascular system will be in danger of breaking down. Exposure to any of the causes referred to above will be sufficient to produce the symptoms of aglobulism, that is, chlorosis; and that when they would not affect the blood of an ordinary non-chlorotic individual. This effect is peculiarly striking when the exciting influence is one which is universally recognised as an important factor in the production of chlorosis, namely want of light; for light is essential in the formation of hæmoglobin, and to the health of the red corpuscle. Thus the special phenomena of uncomplicated chlorosis are those of aglobulism or deficiency of the oxygenating substance of the organism; and they furnish one of the purest examples in the whole range of pathology of the effects of want of oxygen in the system (*see* Blood, Morbid Conditions of). When chlorosis advances to anæmia, by the implication of the plasma, a new series of phenomena present themselves, prominent among which are loss of flesh and œdema of the extremities.

The relation of the cardiac enlargement and valvular disease to the vascular hypoplasia is a purely physical one. More complex is the connexion between the blood-vascular condition and that of the generative organs. The chlorotic diathesis, or actual chlorosis, will manifestly interfere with the development and activity of the ovaries and uterus; whilst, on the other hand, disorders of the sexual functions are amongst the most frequent exciting causes of aglobulism.

Diagnosis.—Chlorosis is to be distinguished from symptomatic and idiopathic anæmia; and the points by which the diagnosis may be accomplished have been sufficiently indicated above. Leukæmia may be readily recognised by a careful examination of the blood and spleen.

Prognosis.—The prognosis is highly favourable as regards life; and a speedy cure may be assured in uncomplicated cases subjected to careful treatment.

Treatment.—The success of a particular method of treatment of simple chlorosis is one of the strongest arguments in favour of the correctness of the preceding view of the pathology of the disease. The condition being one of aglobulism, the treatment employed will be so far simpler than that of anæmia, that the red corpuscles alone have to be restored. While the various measures recommended in the more serious blood-disorder are therefore to be employed, if necessary, it will generally be found that in chlorosis iron alone will be sufficient to effect a cure. The particular form in which the drug is to be presented must be carefully selected according to circumstances which need not be repeated in this article. A free supply of sunlight is essential, and must be insisted upon; and physiological rest of the blood and of the organs of circulation is equally necessary.

J. Mitchell Bruce.

CHOLAGOGUES (χολή, bile, and ἄγω, I move).—Definition.—Substances which lessen the amount of bile in the blood.

Enumeration.—The principal cholagogues are Mercury and its preparations—especially calomel and blue pill; Podophyllum and Podophyllin; Aloes; and Rhubarb.

Action and Uses.—The liver has a twofold action—it *forms* bile, which is poured into the duodenum; and it also *excretes* the bile which has been reabsorbed from the duodenum and carried back to the liver by the portal circulation. Much bile thus circulates continually between the liver and duodenum, while part is carried down the intestine with the fæces, and its place supplied by newly-formed bile. When the quantity circulating in this way is too great to be completely excreted by the liver, it enters the general circulation and produces symptoms of *biliousness*. These are removed by the so-called cholagogues, which probably act by stimulating the duodenum, and thus carrying the bile so far down the intestine as to interfere with re-absorption. Amongst the best cholagogues are the preparations of mercury, which do not increase the secreting power of the liver, nor augment the quantity of bile formed by it. Their utility is greatly increased by combination with a saline purgative, which still further clears out the intestine, and completely prevents any re-absorption of bile. Other cholagogues, such as podophyllin, rhubarb, and aloes, actually increase the secretion of bile by the liver. At the same time, they probably prevent its re-absorption, in a similar way to mercurials and salines.

T. Lauder Brunton.

CHOLELITHIASIS (χολή, bile, and λίθος, a stone).—The condition of system associated with gall-stones. *See* Gall-Stones.

CHOLERA, ASIATIC.—Synon.: Serous cholera, Spasmodic cholera, Malignant cholera; Fr. *Choléra asiatique*; Ger *asiatische Cholera*.

Definition.—Asiatic cholera is a specific disease, characterized by violent vomiting and purging, with rice-water evacuations, cramps, prostration, collapse, and other striking symptoms; tending to run a rapidly fatal course; and capable of being communicated to persons otherwise in sound health, through the dejecta of patients suffering from the disease. These excreta are most commonly disseminated among a community, and taken into the system by means of drinking water, or in fact by anything swallowed which has been contaminated by the organic matter passed from cholera patients. In badly ventilated rooms, the atmosphere may become so fully charged with the exhalations from patients suffering from cholera as to poison persons employed in nursing the sick. In the same way people engaged in carrying the bodies of those who have died from cholera for burial, or in washing their soiled linen, may contract the malady. In a dried condition the organic poison contained in cholera excreta may retain its dangerous properties for a long time.

The disease is endemic in certain parts of British India, where from time to time it assumes a virulent type, and is apt then to spread, through the means above indicated, along the great lines of human intercourse, and so to extend over the world.

History.—Since the days of Hippocrates medical practitioners residing in various parts of Europe have described a disease which they called cholera. The nosology of this affection was hardly a matter of doubt with them, and it is only in modern times that the question has arisen as to whether the cholera commonly met with among us is identical in its nature with Asiatic cholera. Doubtless, if we compare isolated cases we may find that the symptoms which these affections induce are very similar; but those who have lived beyond the endemic area of Asiatic cholera, and watched the disease spread from India over Europe and America, can scarcely mistake this malignant malady for simple cholera. Asiatic cholera was unknown in Europe before the year 1829–30, although it has existed in India for many centuries. It is true we have no accounts of cholera extending throughout the whole of Hindustan prior to the year 1817, but this arises from the circumstance that it was only at the commencement of the present century that the British Government began to bind the heterogeneous principalities of India into union, and thus render it possible for us to gather together authentic details regarding the disease as it spreads from one province to another.

We cannot here fully consider the relations which unquestionably exist between the rapidity of the diffusion of cholera from the East over Europe, and the increased facilities of communication that have lately been established between India, and Persia, and Arabia, also from Hindustan to Russia, and the shores of the Mediterranean. For instance, forty years ago the passage from Bombay up the Arabian and Persian Gulfs could only be undertaken at certain seasons of the year when the winds were favourable, and even then the voyage was tedious and most difficult to accomplish; now large steamers run every week from Bombay to Bassorah and the intermediate ports along the Persian Gulf, and others pass with equal rapidity to the various towns bordering the Red Sea. But although we cannot enter further into this subject, we must, in order to appreciate the nature of cholera, glance at the chronological order of some of the principal outbursts of the disease which have been disseminated from British India over the world.

In 1817 cholera spread rapidly throughout Bengal; extending during the following year over the greater part of Hindustan, and from thence to Ceylon, Burmah, and China. The disease was communicated from Bombay *viâ* the Persian Gulf in 1820-21, and travelled northward, but did not extend into Europe.

During the year 1826 cholera again burst out over Bengal, and passing through the Punjaub, it entered Cabul in 1828, and from thence extended to Persia, and so to Russia during the years 1829-30, and over the whole of Europe and the greater part of America.

In 1840–41 cholera accompanied a British force despatched from Calcutta to China: it broke out among our troops on their voyage to that country, and having spread throughout the Chinese and Burmese empires, it passed in 1843-44 through Kashgar to Bokhara, and so to Cabul. From Afghanistan the disease extended south into Scinde, and westward in 1845-46 through Persia to Russia and Europe, reaching America in 1848.

In 1849 cholera was very fatal over Bengal, and during the season of 1851-52 it was communicated through the Punjaub and Bombay respectively to Persia and Arabia, and in 1853-54 it spread *viâ* Russia and Egypt with frightful virulence throughout Europe and America.

During the years 1860-61-62 cholera prevailed to an alarming extent throughout Bengal and the Central Provinces, and in 1864–65 in Bombay and along the shores of the Red Sea; thence it passed with pilgrims from Mecca to Egypt, and so to Europe, and for the fourth time to America.

These various outbursts of cholera were usually remarkably sudden in their advent, a considerable number of people in the affected locality being attacked by the disease within a few days after it appeared among them. The malady almost invariably died out from amongst the inhabitants of a country under its influence during the cold seasons of the year, to re-appear on the approach of summer. As a general rule the disease was most deadly during the first year of the epidemic; it decreased in violence the second season; and then gradually disappeared, seldom prevailing in any one locality for more than three consecutive years.

Ætiology.—The more we study the history of Asiatic cholera the better shall we understand that every outburst of the disease which has occurred beyond the confines of India might invariably be traced back through a series of cases to that country; the disease has never broken out spontaneously in any other part of the world—no amount of filth, bad food, or climatic influences have up to the present time induced a widespread epidemic of cholera. The inhabitants of coun-

tries far removed from Hindustan, and having limited communication with that empire, such as Australia, have not experienced the disease; whereas those states which have been brought into intimate relation with India have become frequently subject to outbreaks of cholera.

Many of the earliest Anglo-Indian authors declared their conviction that the disease was contagious; others disputed this idea; but all agreed that cholera when extending over a country often settled on the inhabitants of low-lying, ill-drained, and overcrowded localities, and that it frequently left unharmed people residing beyond the affected area, although they might have been employed in attending patients suffering from the disease. It remained for Dr. Snow, in 1854, to explain this apparent mystery, and to demonstrate, as he did by means of the Broad Street case, that the poison which causes cholera is contained in the excrements of those suffering from the disease, and 'that if by leakage, soakage from cesspools or drains, or through reckless casting out of slops and wash-water, any taint, however small, of the infective material gets access to wells and other sources of drinking water, it imparts to enormous volumes of water the power of propagating the disease' (Simon). Cholera patients cannot, in fact, communicate the affection to others, unless by means of the discharges which they pass. Persons attending them run no risk of contracting the disease provided they are protected from swallowing the organic poison passed by the sick; but in badly ventilated rooms, this organic matter having been disseminated in considerable quantities through the atmosphere, may be taken into the system by attendants, and so poison them.

Dr. W. Aitken observes that the evidence in favour of the communicability of cholera by means of water or food contaminated with cholera dejecta has since 1854 become almost overwhelming. A remarkable instance of the kind reported by Mr. N. Radcliffe took place in East London during the year 1866; and previous to this time the circumstances of a case came under the writer's notice, in which a small quantity of a fresh rice-water stool passed by a patient suffering from cholera was accidentally mixed with some four or five gallons of water, and the mixture exposed to the rays of the tropical sun for twelve hours. Early the following morning nineteen people each swallowed about an ounce of this contaminated water—they only partook of it once,—but within thirty-six hours five of these nineteen persons were seized with cholera. In this instance the choleraic evacuation did not touch the soil: as it was passed, so was it swallowed, but (and this is most important to remember) it had been largely diluted with impure water, and the mixture had been exposed to the light and heat of a tropical sun for twelve hours.

Doubtless we have much yet to learn regarding the nature of the organic substance which causes cholera. Professor Pettenkofer holds that if this material after leaving the human body happens to pass into the ground, it may there, under peculiar conditions of soil, moisture, and heat, undergo definite changes, and then, having risen as a miasma into the air, may poison those who are predisposed to the disease; the earth, according to this theory, seems called on to play the part in the *rôle* of cholera which has been assigned in former times to solar, lunar, electrical, or epidemic influences. The conclusions recently arrived at in Bengal by Drs. Lewis and Cunningham rather incline towards this view. The difficulty of working out these problems in relation to the infecting material of cholera is enhanced by the fact, that the human is the only animal which is incontestably subject to its influence. We must, however, refer our readers to some admirable papers by Dr. E. Parkes, published in the *Army Medical Department Reports*, for accurate knowledge on this subject.

Predisposing Causes.—Persons arriving in an infected area are predisposed to the disease. Beyond this fact nothing certain is known concerning the existence of predisposing causes of the disease.

Anatomical Characters.—The external appearances of the bodies of those who have died of cholera present the mottled skin, shrunken and livid appearance of the limbs, and other features hereafter described as characteristic of the disease during the stage of collapse. The temperature of the body rises after death, and it remains warm for some time. Rigor mortis sets in speedily and is sometimes accompanied with muscular contractions, which displace the limbs of the corpse.

With regard to the internal lesions observed after death from Asiatic cholera, the writer's observations lead him to the conclusion, that almost the only alterations noticed in the tissues are due to the physical and chemical characters of the blood having been changed, consequent on its loss of water. The mucous surface of the stomach and small intestines is injected and swollen, and its epithelial cells contain micrococci; this epithelium drops off the surface of the mucous membrane in large patches within an hour and a half after death; and whatever may be the nature of the changes going on in the epithelial coat of the intestinal canal in cases of cholera, there can be no doubt as to its being extensively affected in this disease.

Anatomical changes of a specific nature, especially with reference to the amount of blood contained in the right side of the heart and lungs, have been described by pathologists as being characteristic of Asiatic cholera; and in many instances after death from this disease, if the post-mortem is delayed for a few hours, the right side of the heart will be found full of blood, together with the pulmonary artery and its divisions; while the lungs are collapsed and bloodless. But the writer holds that there are numerous exceptions to this state of the heart and lungs, and that the condition above described is not infrequently due to post-mortem changes; and if the bodies of those who have died of cholera be examined immediately after death, the left side of the heart will be found as full of blood as the right side, but as post-mortem rigidity sets in, the blood is forced from the left ventricle into the aorta, and in fact from the large arteries of the body into the capillaries and veins. He has less hesitation in express-

ing an opinion of this kind, because under similar circumstances he was misled into attributing an important place in the pathology of cholera to the shedding of the intestinal epithelium, as observed after death: more recent researches have, however, convinced him that the shedding of the epithelial cells, *en masse*, is also a post-mortem change, which takes place usually about an hour and a half or two hours after death.

Symptoms.—Asiatic cholera is most deadly at the commencement of an epidemic, and then usually begins without premonitory symptoms. The patient feels well up to within a few hours of the attack, or, it may be, goes to bed and sleeps soundly through the night, and immediately on rising in the morning is seized with violent purging and vomiting. After the first outburst of the disease, as a rule, cholera commences with diarrhœa, the stools being copious and watery, followed by great prostration of strength, with a peculiar feeling of exhaustion at the pit of the stomach; the sick person suffers from nausea, but seldom from actual vomiting or pain at the outset of the attack. If judiciously treated, many patients recover from this, the *first stage* of cholera, but if neglected the tendency of the disease is to grow rapidly worse. The stools become very frequent, and resemble in appearance and consistency the water in which rice has been boiled: these liquid evacuations flow away from the sick person with a sense of relief rather than otherwise; but the patient now commences to vomit, first throwing up the contents of his stomach, and subsequently all the water he drinks, mixed with mucus and disintegrated epithelium; the fluid is ejected from his mouth with considerable force, and this adds to the increasing prostration which is one of the most urgent and marked features of the disease. The patient complains of intense thirst, and a burning heat at the pit of his stomach; he suffers also excruciating pain from cramps in the muscles of the extremities; he is terribly restless; and his urgent cry is for water to quench his thirst, and that some one might rub his limbs, and thus relieve the muscular spasm. Although the temperature of the sick person's body falls below the normal standard, he complains of feeling hot, and throws off the bed-clothes in order that he may keep himself cool. The pulse is rapid and very weak, the respirations are hurried, and the patient's voice becomes husky. His countenance is pinched, and the integument of his body feels inelastic and doughy, while the skin of his hands and feet becomes wrinkled and purplish in colour. The duration of this, the *second stage* of cholera, is very uncertain; it may last for two or three hours only, or may continue for twelve or fifteen hours; but so long as the pulse can be felt at the wrist, there are still good hopes of the sick person's recovery. The weaker the pulse becomes, the nearer the patient is to the *third*, or *collapse-stage* of cholera, from which probably not more than thirty-five per cent. recover. This, however, depends much on the condition of the patient's heart; it is quite possible, although the cases must be rare, that a sudden outpouring of fluid into the intestinal canal has been sufficient to cause syncope and death, among persons suffering from a weak heart, before the liquid contents of the bowels have had time to be rejected either by the mouth or anus. In the third stage of the disease the vomiting and purging continue, although in a mitigated form; and the skin is covered with a clammy perspiration, especially if the cramps are still severe. We now cease to be able to feel the pulse at the wrist, the lividity of the extremities and surface of the body increases, the patient cannot speak above a low whisper, his breathing is very rapid, his eyeballs are deeply sunk in their sockets, and his features are marvellously changed within a few hours. The urine is suppressed. The temperature of his body may fall as low as 94° Fahr. The patient remains terribly restless, longing only for sleep, and that he may be supplied with water. His intellect is clear, but he seldom expresses any anxiety regarding worldly affairs, although fully conscious of the dangerous condition he is in; sleep, and a plentiful supply of drinking water, are the sole desires of a person passing through the collapse-stage of cholera. This condition seldom lasts for more than twenty-four hours, and reaction either commences within that period, or the patient dies in collapse, or passes on into the *tepid stage*, which in ninety-nine cases out of a hundred ends speedily in death. In the tepid stage of the disease the sick person's body feels cold to the touch, but the temperature, as shown by the thermometer, begins to rise very rapidly, sometimes marking 99° or 100° F. The purging and vomiting cease, and the patient lies in a semi-comatose state, his eyes half open, the ocular conjunctiva being deeply congested, the cornea hazy, and the pupils fixed; the pulse can be felt at the wrist, but the respiration is very hurried, suppression of urine continues, the patient's body is bathed in a cold clammy perspiration, the skin becomes of a dusky red hue, and death too frequently closes the scene within a few hours.

On the other hand, the sick person having been in the collapse-stage of cholera some twenty-four hours (it may be a longer or shorter period), the temperature of his body may begin to rise, gradually creeping up to the normal standard; the respiration diminishes in frequency; the pulse returns; the patient can sleep, and after some thirty-six hours may pass a little urine; in fact, the functions of animal life are slowly restored, and the sick person recovers his health. This desirable result, however, is not infrequently thwarted by various complications which arise during the stage of reaction. Of these complications the following are the most important:—suppression of urine; gastritis and enteritis; pulmonary congestion; meningitis; sloughing of the cornea; abscesses over the body; the formation of coagula in the right side of the heart or pulmonary arteries; hæmorrhage from the bowels; and roseola-choleraica.

Diagnosis.—The question of the diagnosis of Asiatic cholera is discussed in the article on Choleraic Diarrhœa.

Prognosis.—The means of forming a prognosis in cholera will be gathered from the preceding account of the disease. Speaking generally, the prognosis depends chiefly upon the stage of the disease, and upon the time of the epidemic—

that is, according as the patient has been seized at the outbreak, at the height, or towards the end of an epidemic.

Treatment.—In the first stage of Asiatic cholera we should endeavour to stop the purging, and without doubt opium is the drug upon which we may with the greatest confidence rely for effecting this purpose. When practising in the endemic area of cholera the writer was in the habit of carrying about pills containing one grain of opium and four of acetate of lead, so that, if called to see a patient suffering from the disease in its early stage, no time was lost in administering one of these pills dissolved in water. The next thing done was to make a large mustard poultice, and apply it over the whole surface of the patient's abdomen. The sick person was ordered to remain in bed, and to be allowed nothing in the shape of food or water; but he might suck as much ice as he felt inclined for.

If, after the first pill, the patient was again purged, a second was given, and a third (but not more) after each loose motion. It often happened that the first or second pill, together with the mustard poultice, ice, and rest, was sufficient to check the progress of the disease, and the patient recovered. Supposing this treatment not to succeed, or that on first seeing the patient it be found that he has passed into the second stage of the disease, we should still prescribe the pill, as above directed, dissolving it in water, because in the solid form it might be rejected entire, and under any circumstances it would take time to be dissolved by the fluid contained in the stomach; the mustard poultice also should be applied, and the sick person kept warm and in bed. Ice is invaluable in this stage of the disease, and unless a person has passed through an attack of cholera, it is impossible to realise the immense relief it affords; it should be given in small lumps, the sick person eating and swallowing as much as he chooses; he will frequently devour a pound or two of ice in the course of an hour, and he cannot take too much of it. In the treatment of cholera there can be no question as to the value of ice. The patient should be prohibited from drinking water or any other fluid beyond that which he gets from the ice. The practitioner must be firm on this point, turning a deaf ear to the entreaties of the sick man or his friends, that he may be permitted to swallow even a small quantity of water, for if they once break through this rule, it will be impossible to limit the amount of liquid the patient will consume. If this treatment does not check the progress of the malady, we may prescribe three grains of acetate of lead and fifteen drops of diluted acetic acid in water every second hour, and fifteen drops of diluted sulphuric acid in water every alternate hour, so that the patient should take a draught, first of one mixture then of the other, every hour. The writer often combines five drops of spirit of camphor with each dose of the medicine, but this drug requires care in its administration, and should seldom be continued beyond five or six doses of from five to ten drops each. Should the vomiting be very severe, in spite of the free administration of ice, a second mustard poultice should be applied over the abdomen; all medicine must then be omitted for an hour and a half, after which time a scruple of calomel may be sprinkled on the patient's tongue, and he should be made to wash it down with a little iced water. The cramps are best relieved by hand-friction, and if very severe, ease may from time to time be given by allowing the patient to inhale some ether. The writer prefers this practice to administering hydrate of chloral, either by the mouth or by subcutaneous injection. Hot water bottles should be applied to the soles of the patient's feet, and also to his legs and abdomen.

Should the disease have reached the collapse-stage there is but little we can do for the patient. Ice must still be given, and, if the purging is frequent, the sulphuric acid draught (but no opium) may be administered every hour; heat and friction may with advantage be applied to the surface of the body; and the patient may now be permitted to drink iced water in moderation, provided it does not increase the vomiting. According to the writer's experience, wine and stimulants, if given by the mouth, do harm in this stage of cholera; but, if the purging has abated, enemas of warm beef-tea and brandy may be administered by the rectum every third hour. When reaction comes on, we must guard against doing too much—it is very rare indeed to see a patient in this condition sink from exhaustion, but probably many lives are lost by endeavours erroneously made, under the idea of keeping up the patient's strength. Iced milk or arrowroot is all that should be allowed to be given by the mouth for some time after reaction has set in; but enemas such as those above-mentioned, administered per rectum every five or six hours, are often beneficial, especially if the stomach remains irritable; and under these circumstances we not unfrequently find that a small quantity of solid food is easily digested, when soup and liquids are rejected. In each case, however, the dictates of common sense and experience must guide the medical practitioner in his treatment of the sick person through the convalescent stage of the disease.

With reference to the treatment of suppression of urine after cholera, we should get the patient to drink about half a pint of water every second hour, so as to add fluid to his blood. Dry-cupping over the loins should be employed; and ten drops of the tincture of cantharides in water administered every hour, until a drachm of the drug has been given. It need hardly be remarked that suppression of urine after cholera is a most dangerous complication, and there is very little that can be done to restore the suspended functions of the kidneys.

Preventive Treatment.—Among persons predisposed to its influence, the infecting material of Asiatic cholera will manifest its effects on the system within five days of having been swallowed, but the poison does not always engender symptoms of virulent cholera. Nevertheless, in milder cases of the disease the evacuations passed by the patient may contain the germs of cholera, and these evacuations are therefore capable, under certain circumstances, of developing a deadly type of the malady; consequently, the following remarks are applicable to instances of so-called *cholerine*, as well as

to the severer forms of cholera. If the disease has appeared within a neighbourhood, a searching examination must be made into the condition and source of the local water-supply, not overlooking that of the milk, which is too often diluted with water before being sold. All surface and doubtful wells (especially those in the proximity of drains and cesspools) should be immediately closed; and it is desirable that the drinking water before being consumed should be carefully filtered. All accumulations of house refuse and filth must be removed; and dirty places, both within and without uncleanly premises, must be freely disinfected and cleansed. There is no necessity when the disease is prevalent for making any alteration in the usual diet; but in times of cholera we cannot too strongly insist on at once checking any tendency to diarrhœa, especially if it be of a watery nature. Many cases of incipient cholera have been prevented from running on into dangerous disease, by the early administration of pills containing four grains of acetate of lead and one of opium, one pill to be taken after each loose motion, to the extent of three pills.

If called to treat a case of Asiatic cholera, care should be taken that the rice-water stools, and the matters vomited, are disinfected by means of bichromate of potash or Macdougall's mixture, which should be poured over the bottom of the vessel into which the evacuations are received from the patient; and directly the dejecta are passed from the sick person, a solution of one part of carbolic acid to twenty of water should be sprinkled over them, and they must be immediately taken from the patient's room, and disposed of as follows:—If the sewage of the locality is conveyed away by means of a constant water supply, the disinfected cholera evacuation should be thrown at once into the sewer. Drains used for a purpose of this kind must, however, be flushed with a mixture containing about an ounce of ferro-sulphate to a pint of water. But if the drainage of the place passes into a cesspool, the disinfected cholera stools should be buried in a deep hole in the ground, removed from wells, and, if possible, from human habitations; it is a dangerous practice, however carefully cholera-stools have been disinfected, to allow them to gain access to a cesspool. The room in which the patient has been treated must be freely disinfected, and his bedding subsequently burnt. If the sick person should die, the corpse is at once to be placed in a coffin containing a mixture of lime, charcoal, and carbolic acid; in fact, the body should immediately be buried in a mixture of this kind, and the coffin with its contents committed to the grave within twenty-four hours of the patient's death.

But after all, as Mr. Simon remarks, infinitely the most important preventive measures to be adopted against cholera are to provide a pure supply of drinking water, good drainage, ventilation, and cleanliness; for these means, if rightly enforced, must prevent the cholera contagion, whether disinfected or not, from acting to any great extent on the population.

The Vienna Cholera Conference has decided that quarantine is inapplicable to the circumstances of cholera; but this subject, together with the duties incumbent on sanitary and port authorities with reference to the preventive treatment of the disease, hardly falls within the scope of this article. C. MACNAMARA.

CHOLERAIC DIARRHŒA. SYNON.: Simple Cholera; Sporadic Cholera; Fr. *Choléra sporadique*; Ger. *sporadische Cholera.*

DEFINITION.—An acute catarrhal affection of the mucous membrane of the stomach and small intestines, attended with vomiting and diarrhœa. The stools consist of a serous fluid, containing a little albumin. The whole system is implicated to a greater or less extent, through the rapid loss of water from the body.

ÆTIOLOGY.—As has already been remarked, it is only of late years that the question has arisen as to whether Asiatic cholera and simple cholera are identical diseases; but it seems probable that any obscurity which may exist on the subject occurs from the impression that similar symptoms are necessarily produced from precisely the same causes. It appears reasonable, however, to believe that, if the infecting matter of Asiatic cholera, when introduced into the intestinal canal, induces changes such as we have described, decomposing animal or vegetable substances, under certain conditions, may excite analogous changes in the mucous membrane of the alimentary canal, the consequence being that in both diseases a drain of serous fluid takes place from the bowels, followed by symptoms of cholera. In the case of Asiatic cholera, however, we believe that the discharges have the power, under favouring conditions, of propagating the disease, whereas the evacuations in simple cholera are in this respect barren. Doubtless climatic and meteorological influences very materially affect the susceptibility of the human subject to disease, and consequently we find that simple cholera, like the malignant form of the malady, is apt to prevail as an epidemic in moist or wet seasons of the year, and especially among people whose bodies are predisposed to pass into a diseased condition, from their having habitually breathed impure air, and consumed unwholesome food and water, or become debilitated from other causes.

In a hot and moist climate like that of lower Bengal, choleraic diarrhœa is an affection which we meet with at all seasons of the year, and it is especially prevalent among infants who are being reared on cow's milk, or on other kinds of food prone to undergo putrefaction. Among the fish-eating Hindoos the writer has frequently seen several members of the same family who have been seized with symptoms of simple cholera, attributable to the patients having partaken of fish which was slightly tainted. In fact, according to his experience, there are few more certain sources of this form of cholera than fish which has gone bad; and it is very evident that whatever the deleterious influence may be which food of this description contains, the mere fact of keeping it in boiling water for some time does not destroy its pernicious qualities.

It occasionally happens that cases of choleraic diarrhœa occur among people residing in malarious districts, the diarrhœa taking the place of the cold stage of a fit of ague; patients

under these circumstances have been seized with all the symptoms of severe cholera, but they have, almost invariably, recovered from the attack.

Symptoms.—Choleraic diarrhœa begins suddenly; that is, the patient, whether an infant or an adult, has probably up to the commencement of the attack been in good health; there are in fact seldom any premonitory symptoms. A child may perhaps look somewhat paler than usual, and has a dark ring under his eyes, but beyond this appears to be perfectly well. Shortly after taking food, the infant vomits up a quantity of uncoagulated milk, the evacuation not being curdled like that from an overloaded stomach, the gastric secretion no longer having the power of coagulating the casein of milk. Soon after vomiting, or it may be before, the child commences to pass from the bowels an acid greenish-yellow fluid, containing flakes and often lumps of undigested food. The little patient becomes very thirsty, restless, and is evidently in considerable pain, crying, and drawing his legs up towards the abdomen. If these symptoms continue the evacuations become colourless, resembling in appearance the rice-water stools of Asiatic cholera. The temperature of the body falls, the face becomes of a dusky hue, the features are contracted, and the eyeballs deeply sunk in their sockets; the fontanelles are depressed, the child is evidently terribly prostrated, his pulse can no longer be felt at the wrist, and his crying passes into a weak whimpering, he eagerly drinks water when offered him; and, as the exhaustion increases, convulsions supervene, and the child dies within a few days or even hours. On the other hand, the symptoms may abate at any stage of the disease, and the little patient gradually recovers his health.

In the adult the symptoms induced by choleraic diarrhœa are much the same as those above detailed. There are seldom any premonitory symptoms, and the attack begins with nausea and vomiting, together with a sensation of exhaustion referrible to the pit of the stomach; the vomiting is speedily followed, or it may be preceded, by purging; copious watery discharges are thus passed out of the body, and the larger and more rapid the evacuations, the more they come to resemble the serum of the blood, which, in fact, drains into the intestinal canal, and passes away from the stomach and bowels. The patient naturally complains under the circumstances of intense thirst: he is very restless, and at the commencement of the attack suffers from colicky pains in the abdomen, and subsequently from spasms and cramps which often seize the muscles of the extremities. The pulse becomes small and weak, the respiration is hurried, the voice feeble, and the countenance pale and shrunken. The urine is scanty or suppressed, and the temperature of the body falls one or two degrees below the usual standard. These symptoms, as a rule, gradually subside, the purging and vomiting cease, and the patient falls off to sleep, waking more or less exhausted in proportion to the severity of the attack, but he usually recovers his health rapidly.

Diagnosis.—The question naturally arises, are there any means by which we can distinguish a case of choleraic diarrhœa from one of Asiatic cholera? and in reply it may be affirmed that there is no characteristic symptom by which these affections can be diagnosed from one another. But, taking all the circumstances of any particular case into consideration, it is difficult, except on paper, to confound the two diseases; for unless a patient has recently imbibed the poison which produces Asiatic cholera, he cannot be suffering from that malady. Should the sick person reside in a neighbourhood affected by Asiatic cholera, we must, in forming an opinion as to the nature of the affection, be guided by the previous history of the case, the nature of the food consumed, and so on, and, above all, by the severity of the symptoms. Choleraic diarrhœa, even in the tropics, rarely passes on within a few hours from the commencement of the attack into collapse, such as is commonly seen in cases of Asiatic cholera; and, in the early stages of the former disease, there is seldom that complete loss of voice and pulse so characteristic of the malignant form of this affection. An experienced medical practitioner, placed at the bedside of a person suffering from Asiatic cholera, even in its earliest stages, feels no doubt whatever as to the nature of the affection, and is at once impressed with the grave responsibility of the charge which rests upon him: his anxiety is infinitely less when he meets with an instance of choleraic diarrhœa, although he is unable to lay down any hard and fast rules by means of which he could define the difference that exists between the symptoms present, and those occurring in a case of Asiatic cholera.

Prognosis.—Although choleraic diarrhœa in its more severe forms resembles mild cases of Asiatic cholera, it is a comparatively harmless disease. Unless among young infants, or old and sickly people, no matter how threatening the symptoms may be, however great the collapse and depression of the patient may seem, a previously healthy adult seldom dies of choleraic diarrhœa.

Treatment.—In cases of simple cholera occurring among children, the important point we must enforce in our treatment is that the affected organ shall have rest. In practice, however, it is often difficult to persuade parents and nurses that an infant can exist uninjured for ten or fourteen hours on iced water; nevertheless, we must insist on a plan of this kind being carried out. The little patient will eagerly swallow cold water, either from a bottle or spoon, and the child may be allowed to take as much cold water as he requires, and to suck ice, which may be wrapped up in the corner of a handkerchief and put into his mouth. A poultice made of equal parts of mustard and flour, applied over the abdomen, is often very useful in this form of disease. With reference to drugs, should the treatment above indicated not relieve the symptoms, or should the vomiting be very constant, four grains of calomel may be given, and repeated if necessary in an hour's time; but if the diarrhœa is the more prominent symptom, calomel is not required, but a teaspoonful of castor oil should be administered, and after the bowels have been cleared out, if the serous discharge continues, we should order astringents, in the form of $\frac{1}{8}$ of a grain of acetate of lead every hour,

or $\frac{1}{16}$ of a grain of nitrate of silver, until the purging subsides. Tannic acid, in combination with dilute sulphuric acid and sugar, is frequently a useful combination to administer to children in cases of this description. With reference to opium, much as the writer dislikes prescribing it for infants, it may be necessary in cases of simple cholera, but it should hardly be given in a mixture to be administered from time to time by a nurse; opium under these circumstances can only be admissible when given by the medical attendant himself, in doses of two or three drops of laudanum in a little weak brandy and water, carefully watching its effects. If the drug causes the child to sleep for a few hours it may act almost like a charm; the infant awakes comparatively well; but if the opium has no such effect, we may be tempted to repeat the dose, but can scarcely give it a third time, at any rate until some hours have elapsed since the administration of the second dose. The symptoms having subsided, the child's diet must be strictly attended to, a good healthy wet-nurse as a rule being an urgent necessity in the case of infants. Lime-water may with advantage be mixed with the child's food.

With reference to the treatment of adults suffering from choleraic diarrhœa, we must bear in mind the fact that, unless among old and debilitated persons, the patient will, as a rule, get well without medicine. If therefore called to prescribe for a case of this complaint, we may order fifteen drops of laudanum, or a drachm of the compound tincture of camphor in water, to be taken (supposing the patient is very sick) immediately after vomiting; half the above dose may be given at the expiration of one hour, and again after another hour, unless the symptoms have in the meantime subsided. A large mustard poultice should be applied over the abdomen, and the patient must be confined to bed, and kept on ice and iced water; he should not, however, be permitted to swallow too much liquid. Among old or weakly persons, and also in the case of infants, it is often very necessary to administer brandy and water from time to time, according to the state of the pulse. If the vomiting is severe, a scruple of calomel may be given to an adult, or in the first instance the effervescing mixture with hydrocyanic acid may be employed to allay the sickness; on the other hand, should the serous diarrhœa be excessive, we may with advantage prescribe four grains of the acetate of lead and ten drops of diluted acetic acid every second hour; or pills containing a drop of creasote, a quarter of a grain of nitrate of silver, a grain of camphor, and two grains of Dover's powder, to be repeated after each loose motion. C. MACNAMARA.

CHOLERINE.—A term applied to a class of cases which occur during the prevalence of cholera, in which the milder symptoms of the disease are present. It has also been used to designate the poison on which cholera is supposed to depend. *See* CHOLERA; and CHOLERAIC DIARRHŒA.

CHOLESTEATOMA (χολή, bile; στέαρ, suet; and ὅμοιος, like).—An encysted tumour, consisting chiefly of cholesterine. *See* CYSTS.

CHOLESTERINE. *See* Appendix.

CHORDEE (χορδή, a harpstring).—DEFINITION.—Painful imperfect erection of the penis during gonorrhœa.

ÆTIOLOGY AND PATHOLOGY.—Chordee is most common in the second and third weeks, and rarely attacks the patient after the third week of gonorrhœa. In exceptional cases, on the contrary, chordee, absent in the acute stage, is violently developed after the inflammation has become chronic and very slight. The bulbous part of the urethra is generally intensely inflamed when chordee happens; and, further, chordee is very uncommon when the urethritis is limited to the anterior or posterior portions of the canal.

The *mechanism* of chordee is imperfectly understood. Two explanations have been put forward:—(*a*) That the corpus spongiosum surrounding the urethra being affected by inflammation through the effusion of lymph into its substance, proper distension of its spongy tissue and elongation during erection cannot take place. Hence it is drawn tight like a bowstring by the arching of the distended corpora cavernosa. (*b*) That the inflammatory condition of the mucous membrane and submucous tissue at the bulbous part excites reflex spasm of the muscles surrounding that part of the corpus spongiosum. This prevents distension of the parts compressed; while the corpora cavernosa, being untrammelled, continue to expand in the ordinary manner. The first explanation is insufficient to account for some cases where the inflammatory action is very slight and there is no evidence that lymph has been effused into the erectile tissue; for example, after a plastic operation on the penis. Again, natural erection has been known to take place very shortly after the subsidence of gonorrhœal irritation, and, it is fair to suppose, before effused lymph can have been absorbed. The second explanation is unsatisfactory, because spasm of other muscles of the perinæum is often absent. Probably both methods may be active in producing chordee.

The causes of chordee are *indirect* or *direct*. The most common indirect cause is urethritis or urethral congestion. Direct causes are the reflex irritants which usually produce erection during sleep, such as stimulating food and drink, strongly acid urine, great superficial warmth of the body, distended bladder, lascivious dreams, &c.

SYMPTOMS.—The organ grows suddenly turgid and assumes a bowed or crooked form, causing acute pain, which is felt at the part and towards the perinæum. In severe cases the strain causes rupture of the mucous membrane and spongy tissue, with hæmorrhage. The loss of blood is usually limited to a few drops, and gives relief to the pain. Rarely the hæmorrhage is rapid and prolonged.

TREATMENT.—Abstinence from stimulants of all kinds and late suppers; light clothing; and a hard mattress at night are the best means of preventing chordee. Micturition at short intervals during the night must be enjoined. Of medicines the best is a suppository at bed-time of one grain of crude opium in ten grains of cocca butter. The subcutaneous injection into

the perinæum of one-sixth grain of acetate of morphia is also an effectual remedy. Both these applications should be followed by an aperient saline draught the next morning. A drachm of spirit of camphor thrown just before it is swallowed into an ounce of water, and taken on lying down at night is also useful, and it may be repeated once if chordee awaken the patient, but it is a very uncertain remedy. More trustworthy are twenty or twenty-five grains of chloral-hydrate in syrup and water at bed-time, and repeated in four or six hours if needed. Bathing the genitals and perinæum with very hot water for ten minutes before going to bed sometimes proves successful. The application of a spiral coil of narrow india-rubber tubing round the penis and scrotum, through which a continuous current of ice-cold water flows, is also an excellent preventive.—To disperse an attack of chordee the best remedies are voiding urine; the application of cold to the perinæum by evaporating lotion or by ice; and the upright posture. BERKELEY HILL.

CHOREA (*χορεία*, a dance).—SYNON.: Chorea Minor; St. Vitus's Dance; Fr. *Danse de St.-Guy*; *la Chorée*; Ger. *Veitstanz*.

DEFINITION.—A disease of the nervous system, characterised by a succession of irregular, clonic, involuntary movements of limited range, occurring in almost all parts of the body.

The distinctive features of the movements are the entire absence of either rhythm or method in their recurrence; that not individual muscles but co-ordinated groups are affected; and not one or more groups only, but almost all the muscles in turn. There is not actual loss of command over the muscles, but voluntary movements are interfered with by superaddition of involuntary movements. As a rule the movements cease during sleep.

ÆTIOLOGY.—Chorea is a disease of childhood; it is most common between the ages of eight and twelve, very rare before six, and rare after sixteen; it is more than twice as frequent in girls as in boys, especially after the age of nine. It occurs more frequently in families in which nervous diseases are hereditary than in others. It is more common in large towns than in the country; and far more frequent among the poor than among those in comfortable circumstances. Want of proper food, neglect, ill-usage, with the weakness and anæmia induced by these means, are very common antecedents. Children well-nourished and with a good colour, exposed to none of these causes, may however suffer. An intimate association between chorea and rheumatism has long been recognised. A large proportion of the children suffering from chorea are found to have had acute or subacute rheumatism, and some of the most terrible cases met with, especially after the age of puberty, are those in which the chorea comes on during or just after acute rheumatism. Whether traceable to rheumatism or not, there is very frequently found in chorea a cardiac murmur, usually mitral systolic, sometimes aortic. This may or may not disappear after recovery. In almost all the fatal cases of chorea which have been examined after death, endocarditis with fibrinous vegetations on the valves has been present. In adults, pregnancy divides with rheumatism the causation of this affection; recovery generally speedily follows delivery, and can rarely be brought about till this has taken place. Bad habits, and disorders of menstruation, are also said to be capable of inducing chorea. Intestinal worms again have appeared to set up the disease, and instances are on record in which the expulsion of worms has been followed at once by cessation of the movements, but this must be extremely rare. Fright or some powerful emotion is very frequently assigned as a cause; and it is seldom that parents are not prepared with the instance required. But, making allowance for this, and notwithstanding the fact that endocarditis may be present in cases said to have originated in fright, it does not seem possible to exclude fright as a cause of chorea. The influence of imitation is less certain. The disease is said to be far less common in negroes.

ANATOMICAL CHARACTERS AND PATHOLOGY.—The study of chorea, as of epilepsy and many other affections of the nervous system, has been hampered by its being regarded as a morbid unity. The view here maintained is that it is a sympton rather than a disease, and that the characteristic movements are in relation not with the *nature* of the morbid change but with its *seat*. The seat of the disturbance is the corpus striatum, its character probably different in different cases; but the anatomical condition cannot amount to actual breach of structure, since that is known to give rise to hemiplegia, while it must obviously be of a kind to impair the functional vigour of the ganglia. Chorea, as the writer has said elsewhere, has been called 'insanity of the muscles'—a better phrase would be 'delirium of the sensori-motor ganglia.' In delirium there is loss of control over the mental processes with rapid succession of incoherent and imperfect ideas; in chorea loss of control over the motor apparatus, with movements excessive in point of number and extent, but wanting in vigour and precision.

In some cases of chorea nothing abnormal has been detected after death, but usually the minute methods of investigation now pursued yield positive results. The largest series of examinations published is contained in a communication to the Medico-Chirurgical Society, in the session 1875–6, by Dr. Dickinson. He describes dilatations of the minute arteries as existing throughout the brain and cord, more especially, however, in the corpus striatum and thalamus, with small hæmorrhages; and considers the disease to be due to a widely-spread hyperæmia of the nerve-centres. He did not find capillary embolisms, but does not appear to have drawn out the arterioles to look for them. The appearances he describes are very much those producible by impaction of microscopic particles of fibrin in the minute vessels. Capillary embolisms have been found by Dr. Tuckwell and other observers, predominantly in the central ganglia, but also in the convolutions and cord, accompanied by patches of softening and minute hæmorrhages. In almost all fatal cases of chorea there is endocarditis with deposit of beads of lymph on the mitral or aortic valves or both, whether a murmur has been audible during life or not.

The post-mortem appearances consequently do not indicate any localisation of the morbid change in the central ganglia. But it is to be remembered that the fatal cases are those in which there is not only extreme violence in the choreic movements but usually also delirium and other symptoms. There are in fact multiple symptoms just as there are multiple lesions, and we are called upon to distribute the symptoms and assign them to their respective sources by such knowledge of the functions of the different nerve-centres as physiology affords us. The delirium or comparative dementia is thus attributed to the lesions in the convolutions; the loss of speech to lesions in convolutions or in lower centres, according to its character; the impairment of sensation to lesions in the thalami; the chorea to lesions in the corpora striata. The grounds upon which this last localisation—that in which we are immediately concerned—is decided, are as follows. We exclude the cerebral hemispheres and cerebellum, rather arbitrarily perhaps, since there is much to be said in favour of their contributing to excite the movement, now especially that convolutional motor areas have been demonstrated by Hitzig and Ferrier. The important point to be made clear, however, is that chorea has not its seat in the cord. The arguments and evidences against this are (1) That *tonic* and not *clonic* spasm is characteristic of persistent spinal irritation; (2) The degree of control over the movements retained by the will; (3) Their increase under emotion; (4) Their cessation during sleep. To those which were originally advanced by Dr. Russell Reynolds may be added: (5) The diminished reflex action on tickling; and (6) The phenomena of hemichorea and its relations with hemiplegia. The evidence afforded by hemichorea is so conclusive that other considerations have been merely alluded to. It cannot be supposed, for example, that one lateral half of the entire length of pons, medulla, and cord can be affected without implication of the other half, which would be the case with hemichorea of spinal origin; and still more conclusive is the fact that when in hemichorea there is impairment of sensation it is on the same side with the movements, and not, as in hemiparaplegia (due to division of one half of the cord), on the opposite side to the motor paralysis. The parallelism between hemichorea and hemiplegia is so perfect as to suggest at once that the two affections represent different conditions of the same nerve-centres, and is made more complete by the very discrepancies, as they may at first sight appear, which have been considered to be objections. In hemiplegia there are certain muscles which more or less completely escape paralysis: the motores oculorum, orbiculares palpebrarum and other facial muscles, the muscles of the neck, chest, back, and abdomen. In hemichorea the irregular movements cross the median line and invade the opposite side in these same muscles. This has been explained (rightly or wrongly) by the hypothesis that all these muscles acting in compulsory concert with the corresponding (or other) muscles of the opposite side, the nerve-nuclei of the bilaterally associated muscles will be commissurally associated in the cord, so as to become in effect a single nucleus, and this single nucleus for muscles on each side of the body being connected with both corpora striata is thrown into action by the sound corpus striatum when its fellow of the opposite side is damaged, as in hemiplegia, thus preventing paralysis; and, on the other hand, is reached by the irregular impulses from the corpus striatum affected in hemichorea, thus causing bilateral chorea in the parts enumerated.

In addition to the correspondence between hemichorea and hemiplegia just described, there are transitions from one to the other, and combinations of the two to be mentioned below, under the head of complications. Hemiplegia may be succeeded by hemichorea (the *post-hemiplegic chorea* of various observers); or chorea may deepen into paralysis; or, as in a case reported by the writer, there may be with chorea of the limbs on one side, first chorea, then paralysis (hemi plegiform), and then again chorea of the same side of the face. The conclusion is obvious, that hemiplegia and hemichorea in these cases are indicative of different degrees of damage in the same centre. Hemichorea and hemianæsthesia have been found very constantly associated with structural lesions in the white fibres just outside the posterior extremity of the thalamus, usually involving also the ganglion itself at this part.

The well-known embolic theory of chorea originated by Kirkes, and improved and ably maintained by Dr. Hughlings Jackson, at once finds its place here. Capillary embolism is of all others the condition which might be expected to induce the instability without abolition of function which exists in chorea, and in almost all cases a fertile source of fibrinous shreds is present, in the form of vegetations on the valves of the heart; the fact of embolism, again, has repeatedly been demonstrated. While, however, giving to capillary embolism a prominent place among the causes of chorea, it cannot be considered as the only cause. The clinical differences between ordinary chorea and the acute and fatal form are of themselves suggestive of a different pathology; and the speedy recovery after delivery in the chorea of pregnancy, or (as in one or two cases on record) after expulsion of intestinal worms, is inconsistent with the existence of embolism. What the precise anatomical condition is can only be matter of conjecture, but it will be some form of innutrition, irritability, and debility, as Dr. C. B. Radcliffe has abundantly demonstrated, going together. Hyperæmia, with capillary blood-stasis, or capillary thrombosis by cohering leucocytes, has been suggested as the cause. Prolonged arterial spasm from persistent reflex irritation, uterine or intestinal, or the more brief contraction of the cerebral vessels from fright, may perhaps lower the functional vigour of the ganglia to the degree required. A very important consideration is the remarkable limitation of chorea to the period of childhood—the period between infancy and puberty. This is a limitation, if not without parallel, certainly unequalled, and it points to a condition of nerve centres in childhood which specially favours the occurrence of the disease. This condition may be said with confidence to be the fact that childhood is the period of special activity of the sensori-motor ganglia.

Symptoms.—In a slight case the patient, usually a child, may be perfectly quiet when lying down, and for a short time even when sitting or standing, if not conscious of being under observation; but when walking or while under examination there will be various fidgety actions, abrupt flexion of the fingers, a sudden pronation of the forearm, or hitching up of one shoulder, or twist of the body, or there is shuffling of a foot on the floor, or again a jerk of the head or twitch of the mouth or eyes. If the patient be told to do anything, the movements will be multiplied and exaggerated in the muscles employed. A small object will be picked up and held, but the hand is brought down upon it hastily and after various irregular excursions. In a more severe case the grimaces, contortions, and jerkings succeed each other without intermission. The gait is now very peculiar, being slow, shuffling, and uneven; the steps of irregular length and unequal time; and the line of progress deviating. In the worst forms of this disease every muscle appears to be thrown in turn into violent contraction, the face is distorted this way and that, the eyes roll to and fro, the teeth are snapped or ground together, the whole body writhes, and the limbs are in unceasing motion. It is to be remarked that, even in extreme cases, the movements, violent as they may be, are in some degree circumscribed; the arms, for example, are not thrown up over the head, nor do the legs go to the full extent of their range of motion; the tongue is rarely bitten, though the lips may be. Deglutition is greatly interfered with in a severe attack, and the evacuations may be discharged involuntarily. In the mildest forms, the diaphragm and muscles of the chest and abdomen are affected, causing irregularity in respiration. The action of the heart may also be irregular, but this is probably secondary to the respiratory variations in frequency and depth, and is not attributable to chorea of the heart. There is generally impairment of motor power, and frequently diminution of sensation. This is most readily ascertained in hemichorea, *i.e.* chorea affecting one half of the body only, when the sound side can be employed for comparison; but in the violent forms of the disease, when the skin is gradually worn through by incessant friction, there is often so little complaint of pain that sensibility must, it would seem, be blunted. Reflex sensibility is also, commonly, dull.

It has already been stated that the movements cease during sleep; this is a rule to which exceptions are rare though not unknown, even in mild cases, and especially in hemichorea.

Chorea is usually gradual in access, even in the cases which ultimately become severe; it is very commonly one-sided for a time, and occasionally throughout, when the name hemichorea is given. It is not, however, strictly unilateral in these cases, as the movements transgress the median line and affect the corresponding muscles of both sides of the body at those parts where these are bilaterally associated, and where in hemiplegia there is immunity from the paralysis, as for instance the oculo-motor muscles, the muscles of the neck, chest, and abdomen.

Complications.—The foregoing description applies more or less to all cases of chorea, but there are often additional symptoms, and it will conduce to clearness if these are considered apart and called complications. Mention has been made of impairment of motor power; at times this amounts to complete paralysis, and the relations and combinations of chorea and paralysis, and especially of hemichorea and hemiplegia, throw much light on the disease. Chorea sometimes succeeds hemiplegia in the paralysed parts; more rarely chorea deepens into paralysis. Cases again occur in which with facial hemiplegia there is chorea of the limbs of the same side. Speech is very commonly more or less affected and occasionally completely lost for a time. The difficulty is usually articulatory, chorea of the muscles of respiration, phonation, and articulation interfering with utterance of words; but there is in some cases true aphasia, and when this is so, there is the same tendency to the association of aphasia with right hemichorea as with right hemiplegia. The intellect may suffer in various degrees: the face has often an idiotic expression in chorea, usually no doubt from the muscular contortion or atony, but sometimes truly indicative of temporary imbecility. In the violent and fatal forms of chorea there is almost always delirium. Impairment of sensation is common, and hemianæsthesia is almost always associated with hemichorea.

Duration, Terminations, and Prognosis.—The average duration of chorea is about two months; if prolonged beyond three months it may be exceedingly chronic and go on better and worse for one or two years. There is a tendency to spontaneous recovery, but on the other hand relapses are common. Chorea is rarely fatal in children; when it is so the case is usually acute and violent from a very early period of the attack, and it is rare for a case to run the usual course for a time and then take on a very severe character. After puberty and especially when it supervenes on acute rheumatism, it is very dangerous, but less so when associated with menstrual disorders and pregnancy than in youths or men.

Diagnosis.—It is only necessary under this head to warn against the mistake of confounding with the movements of chorea the tremor or jactitation of disseminated sclerosis of the nerve-centres, which, though most common in adults, is not unknown in childhood.

Treatment.—In a large proportion of cases of chorea, especially such as come into the hospitals of London, rest and food, with perhaps aperients, are all that are required for recovery. But it can scarcely be denied that medicinal treatment often renders important services, especially in cases of a lingering character. The causation and pathological condition being various, it is to be expected that the remedies required will be different, and the attempt should be made to adapt the treatment to the special features of the case, the basis of all being the endeavour to improve the nutrition of the body generally, and of the nervous system, by good food, rest, and warmth. The food may be supplemented by cod-liver oil, and Dr. C. B. Radcliffe attaches importance to the free administration of wine or other stimulants. Any recognised cause should be removed, such as constipation or worms; irregularities or suspension of the catamenia

should receive attention; when there is pregnancy it may perhaps be necessary to induce premature labour. When the chorea is accompanied by rheumatoid pains and feverishness, iodide of potassium with ammonia may have a remarkably good effect. Iron in some form or other is very generally useful, but especially when the patient is anæmic. Another remedy is sulphate of zinc, given in doses gradually increasing from one or two grains three times a day, to six, eight, or ten, till sickness is induced, when in some cases the disease appears to be cut short. The remedy which in the writer's experience has been found most generally useful is arsenic. Trousseau sometimes gave strychnine in gradually increasing doses till its physiological effects manifested themselves. On the other hand, conium, recommended by Dr. John Harley, has been extensively employed; the only reliable preparation is the juice, which should again be given in gradually increasing doses, beginning with a drachm and going up to one or two ounces if necessary, till its depressing effect on the muscles becomes evident. It has not, in the writer's hands, given satisfactory results; the same may be said of the application of ether-spray along the spine, which has recently been strongly recommended, except in acute cases in which the freezing of the skin here has in two cases been followed at once by sleep, and in a few days by alleviation of the violence of the chorea. Baths, warm and cold, especially shower-baths, spinal douches, spinal ice-bags, gymnastics, musical gymnastics, *i.e.* movements timed by music, have advocates and may no doubt be useful in suitable cases.

In the terrible cases of acute chorea the great indication is to procure rest for the poor sufferer and keep up the strength. Milk, eggs, beef-tea and other forms of concentrated fluid nourishment, should be given freely, together with wine or brandy. Conium, hyoscyamus, bromide of potassium or ammonium, and chloral, have been tried separately or in combination, with more or less appearance of success; chloroform, again, may be administered; chloral by the mouth or rectum, and hypodermic injection of morphia with free administration of brandy have in the writer's judgment appeared to do much good. It is in these cases that tartar emetic in full doses has been recommended; it is certainly tolerated in an astonishing degree. Restraint of the violent movements is often a great comfort to the patient; the limbs should be carefully bandaged with flannel and bound, the legs together, the arms to the sides, a folded blanket, across the abdomen and hips, keeping down the body. If half-done it only adds to the suffering, but when properly carried out it gives a feeling of relief and favours sleep. W. H. Broadbent.

CHOROIDITIS. — Inflammation of the choroid. *See* Eye, Diseases of.

CHROMIDROSIS (χρῶμα, colour, and ἱδρῶς, sweat), coloured perspiration. *See* Perspiration, Disorders of.

CHRONIC (χρόνος, time).—This word is applied to a disease when its progress is slow and its duration prolonged. *See* Disease, Duration of.

CHYLOUS URINE.—*See* Chyluria.

CHYLURIA (χυλός, chyle; and οὖρον, urine). —Synon.: Galacturia; Chylous urine; Fr. *Urine laiteuse*; Ger. *Die Chylurie*; *milchsaftiger Harnabgang.*

Definition.—A diseased condition, occurring in tropical and sub-tropical climates, which manifests itself by a milky appearance of the urine, accompanied usually with more or less distinct traces of blood. On standing, the fluid coagulates, so as to present the appearance of size. A microscopic nematoid entozoon (*Filaria sanguinis hominis*) is generally found in the blood and urine of persons affected with the disease.

General Description.—The affection known as chylous or chyloid urine has long remained a puzzle to physicians, not only on account of the very remarkable character assumed by the secretion, but also on account of the very erratic course which the disease runs. Scarcely any two persons affected with this malady give a similar account of its mode of onset, of the duration of the attack, or of the symptoms and seasons of its occurrence. The writer has had the opportunity of studying from thirty to forty cases of the disease in Calcutta, and the variety of symptoms presented, and the numerous causes, of the most opposite character, to which the disease has been attributed, are very perplexing. The histories of the cases published by various observers present a like uncertainty, and Dr. William Roberts very aptly describes the course which the disease runs as marked by an irregularity and capriciousness which baffles explanation. It would seem as though the one symptom which may be looked upon as constant is the condition of the urine implied by the designation which was applied to the disorder by Prout.

This symptom, however, although very applicable to the generality of cases met with in India, does not appear to be so generally applicable to the disease as it occurs in Egypt, the Brazils, and the West Indies. In these countries the term *hæmaturia* is adopted as being a more correct description of the malady, whereas in India the designation 'hæmaturia,' though generally more or less applicable at some period or other of the disease, is, nevertheless, not so appropriate in the great majority of the cases, and, indeed, in some instances is wholly inappropriate, as occasionally no marked traces of red colouring matter can be detected in the urine from the beginning to the close of the attack. It is of importance that this feature in connection with the disease should be borne in mind, as it may hereafter be found that what at present are generally considered as merely two phases of one malady may each have a distinctive ætiology.

History and Geographical Distribution.—The phase which chyluria usually presents in India is, in this article, taken as the typical one, and its history may be thus briefly epitomised. To Dr. Vandyke Carter belongs the credit of having observed systematically, and seriously attempted to clear up the pathology of the disease. His researches, published in 1861–62 tended to show that a direct admixture of chyle and urine occurred—a leak from the lymphatic tract into the urinary.[1] In March 1870, when

[1] *Transactions Med. and Phys. Soc. Bombay*, vol. vii. 1861. *Medico-chir. Trans.*, vol. xlv., 1862.

examining a specimen of milky urine passed by a man under the charge of Dr. R. T. Lyons in Calcutta, the writer found that it contained numerous microscopic nematoid worms in a living condition. These were described and figured in a report published in 1870 by the Indian Government.[1] Under the impression that no nematoid parasites had previously been found in the urine, specimens were forwarded to the late Dr. Parkes, and by him shown to Professor Busk, who suggested that probably they belonged to the Filaridæ. Similar entozoa were detected in the urine of chyluria patients in Calcutta by Dr. W. J. Palmer and Dr. Charles in the course of the next few months. Towards the beginning of July 1872 the writer found nine minute nematoid worms in a state of great activity on a slide containing a drop of blood from the finger of a Hindoo. These were identical in character with those above referred to. Unfortunately the man could not be found after the observation had been made, so as to be questioned as to his past history, so that the pathological conditions which might have been associated with this the first recorded instance of the existence of nematoid hæmatozoa in man must continue to remain in obscurity. However, since this period the writer has traced the helminth (named *Filaria sanguinis hominis*) to the blood *direct* in about fifteen, and to one or other of the various tissues and secretions of the body in about thirty-five individuals. All with the exception of the person just referred to were known to suffer or to have suffered from chyluria or some closely allied pathological condition.[2] These observations have, moreover, been confirmed by others in numerous instances.

The more recent history of the variety of the disease usually referred to as 'hématurie graisseuse,' 'hæmaturia Braziliensis,' 'hæmaturia Egyptica,' is also associated with an entozoon—or rather with two distinct kinds of entozoa—a fluke and a nematode. The former was discovered in 1851 by Bilharz. His observation was followed up, and now it is estimated that about a third of the inhabitants of Brazil harbour this parasite in their bodies. In 1868 Dr. Otto Wucherer, of Bahia, discovered a microscopic entozoon, which he forwarded to Leuckart to be identified.[3] The latter writer suggested that it might be the embryo of some round worm, probably belonging to the strongylidæ. Dr. Jules Crevaux, a French naval surgeon, succeeded in confirming Wucherer's observation by finding (July 27, 1870) similar helminths in the urine of a young creole affected with 'hematurie chyleuse.'[4] The next link in the chain appears to have been furnished by Dr. Sonsino, who, in January 1874 (having no knowledge of previous observations of a like character), found similar parasites in the blood and in the urine of a Jew lad at Cairo affected with hæmaturia. In the latter fluid distomata also were found. This observer, however, considers that these parasites, though bearing a very close resemblance, differ in some respects from those found in chyluria, and has accordingly added the word *Egyptica* to the original designation for the purpose of distinguishing it. It is possible that the microscopic nematode which was discovered by Wucherer in Bahia may also be traced to the blood eventually, and that the slight differences in the recorded characters in the worm as found in Egypt and in the Brazils from that found in India may be shown to be sufficient to indicate a specific difference in the parasites, and thus offer a satisfactory explanation of the discrepancies observed in the character of the urinary disorder in the different countries.

In Europe the disease has been investigated by several observers. The cases which have come under their care have occurred with very rare exceptions in persons who have at some time or other resided in countries situated between about 30° north and 30° south latitude. Of the four or five cases which have been recorded as having originally occurred in Europe, one is furnished by Dr. William Roberts, the patient never having been out of Lancashire; and another by Dr. Beale, in a person who had never resided out of Norfolk.[1]

Symptoms.—So far as is at present known, there are no premonitory symptoms of chyluria. Sometimes the only symptom is the milky condition of the urine—a condition which usually comes on very suddenly; generally, however, the patient complains of uneasiness, scarcely amounting to pain, across the loins, along the ureters, over the bladder, or along the course of the urethra—especially towards the perinæum in the male. There is generally marked debility, with mental depression. Occasionally chylo-serous discharges take place from various parts of the body—the axilla, the surface of the abdomen, the groin, and especially from the scrotum, in that condition of it which is known as Elephantiasis lymphangiectodes (Bristowe), Nævoid elephantiasis, or Varix lymphaticus. The disease is also sometimes observed associated with true elephantiasis of the limbs and scrotum. It occurs at all ages, from childhood to extreme old age, and in about equal proportion among the sexes—perhaps more frequently in the female than in the male.

With regard to the *urine*, it presents, as already mentioned, a milky appearance, and frequently emits a strong milky or whey-like odour, which is made more evident by warmth. After standing a short time the fluid coagulates, so as to form a more or less semi-solid mass resembling blancmange. In the course of a few hours the clot breaks down, and the urine becomes rapidly de-

[1] *Vide* abstract of this description in *British Medical Journal*, Nov. 19, 1870.

[2] 'On a Hæmatozoon in human blood; its connection with Chyluria and other diseases.' *Vide Eighth Ann. Rep. of Sanitary Commiss. with Govt. of India*, 1872; also *Indian Ann. Med. Science*, vol. xvi.

[3] 'On the Pathological Significance of Nematode Hæmatozoa.' *Tenth Report of Sanitary Commiss.*, 1874; also *Indian Ann. Med. Science*, vol. xvii.

[4] *Gazitta da Bahia*, Dec. 1868.

[1] *Journ. de l'Anat. et de la Physiol.* T. xi., 1875; and Leuckart's '*Parasiten*,' Band ii. S. 628 *et seq.*

[1] Dr. S. Mackenzie exhibited to the Pathological Society (October 1881) living specimens of filaria from a soldier who had served in India. He noticed the daily periodicity of the filaria, which had previously been determined by Dr. Manson of Amoy, and further showed that the periodicity could be inverted from day to night by changing the habits of the individual.

composed. In some cases the fluid presents a pink colour, from the admixture of blood, but more commonly—at least, in India—the blood, when present, is seen forming a shreddy adherent coagulum at the bottom of the vessel. Not unfrequently the flow of urine is suddenly stopped during micturition by the blocking up temporarily of the urethra with one of the clots. Sometimes in India, but apparently almost always in the West Indies, South America, and Egypt, the presence of blood in the urine forms, as already mentioned, the most pronounced feature. The specific gravity varies greatly—may range in the same individual from 1007 to over 1020. Shaken up with ether the urine loses its milky aspect; and when nitric acid or heat is applied a precipitate almost invariably results. These characters, and the fact of the coagulability of the fluid, indicate the presence of fat, albumen, and fibrin, all of which are to be considered as abnormal constituents. The proportion, however, in which they exist in different individuals, and even in the same individual at different times, varies greatly. Dr. Beale's analyses show, that though a specimen of urine may contain at one time 1·39 per cent. of fat, another specimen, obtained a few hours later, from the same person, may contain none. In the majority of cases the fatty element is usually scanty in the morning before meals, and so are the other abnormal elements, unless exercise have been taken or the circulation otherwise accelerated. Under the latter circumstance, as Dr. Bence-Jones has shown, the albumen is increased, without, however, a corresponding increase of the fat.[1] It is evident, therefore, that in order to institute a comparison between the character of the urine and the character of the various nutritive fluids for the purpose of ascertaining from which of them the abnormal constituents of the urine are derived, the results of analyses of the latter fluids at different times of the day and at different stages of the disease should be taken. Further, as the nutritive fluids themselves undergo constant changes dependent on the quality of the nourishment supplied and the time which has elapsed since partaking of it, it is equally evident that any single analysis would be insufficient. An attempt has been made to bring together in the following table all of what appeared to be the most trustworthy analyses of these fluids which have been published. In order to simplify the table, only the estimates of the albuminoid and fatty matters have been given, these being the most pronounced of the more readily estimated abnormal constituents in the urine:—

Constituents selected.	Urine in chyluria. [Mean of 15 analyses].	Blood in chyluria. [Hoppe-Seyler.]	Blood—Normal human. [Becquerel and Rodier.]	Chyle [Mean of 6 analyses: man, cow, horse, ass, dog, cat.	Lymph—human [Mean of 4 analyses].
Albuminoids	0·54%	3·35%	7·00%	7·08%	2·96%
Fatty matters.	0·30%	0·67%	0·06%	0·92%	0·56%

[1] *Phil. Trans. of Royal Soc.*, cxl., 1850, p. 651.

A glance at this table reveals the fact that the relative proportion of the albuminoids to the fatty matters in chylous urine does not correspond with the proportion in which they are found in any one of the nutritive fluids of the body. In normal blood, for example, the fatty matter is as 1 to 116 of the albuminoid, whereas in the urine the former exceeds the latter to a very considerable extent. The same discrepancy, but to a less degree, is found to exist when the urine and chyle are compared—the quantity of albumen in the latter being more than seven times greater than that of fat. The proportion of these substances in lymph approaches more closely to what is encountered in the urine—the fat being to the albumen as 1 to 4 very nearly. The specimen of chyluria-blood recently analysed by Hoppe-Seyler[1] approaches very closely to the average composition of human lymph—the fatty matters being as 1 to 5 of the albuminoid, thus differing in this respect very considerably from Dr. Bence-Jones' analyses of similar blood where the quantity of fat given is that of normal blood. On the other hand, the urine of the man from whom this blood was obtained yielded a proportion of fat almost identical with what Hoppe-Seyler obtained in the urine of the person whose blood he examined—the figures given by the former writer being 0·74 and by the latter 0·72 per cent. The composition of the blood in this affection must be regarded as hitherto unsettled. Guibort found in a clot of it almost twice, and Hoppe-Seyler about eleven times as much fat as is found in normal blood; on the other hand, Rayer, Bence-Jones, and Crevaux could detect no change in its composition. It is possible that the discrepancy in the results of these analyses and macroscopic examinations of the blood may be due in part to the particular moment when the blood was abstracted. According to M. Claude Bernard, 'Les urines chyleuses resemblent au sang d'un animal en digestion, ou plutot à celui des oies que l'engraisse.'[2]

With regard to the *microscopic examination of the blood*, the writer has not observed that the corpuscles or serum presented any abnormality indicative of the presence of fatty matter in any form—the serum has seemed as clear and as free from molecular matter as normal blood. So far as his experience goes, the only feature worthy of special note in connection with microscopical examination of the blood in chyluria, is the presence of the hæmatozoon already referred to. In searching for it, it will be advisable to abstract by means of a needle a drop of blood from several fingers, and to submit each slide to a thorough examination, which may have to be very prolonged, employing for this purpose a comparatively low power—$\frac{2}{3}$″ or $\frac{1}{2}$″ objective—a higher power being resorted to when the entozoon has been detected. It must not be expected that the blood will present any peculiarity to the naked eye, even though every ounce may contain thousands of these microscopic worms. The accom-

[1] *Med.-chem. Untersuchungen*, 1871, s. 551–56. Abstract by Dr. Ferrier in *Journ. Chem. Soc.*, vol. ix., 1871; page 740.

[2] Quoted by Crevaux, *op. cit.*

panying wood-cut, traced from a micro-photograph, accurately represents the size and form of the parasite. Its average length is $\frac{1}{75}''$ (=0·34mm.); its breadth $\frac{1}{3500}$ (=0·007mm.), or about equal to the diameter of a red blood-corpuscle. It is enclosed in a transparent tubular sac, within which it can be seen to alternately contract and elongate itself. This sac is extremely delicate and translucent, and may sometimes, when the worm has shortened itself more than usual, be seen collapsed and folded like a ribbon, and the next moment be instantaneously straightened again, by the extension of the filaria to its ordinary length. After death the worm may occupy either the entire length of the tubular sac, or be so contracted as to leave the tube empty at one or both ends, as may be observed in the wood-cut.[1] The internal organs are not sufficiently differentiated to be recognised with anything like certainty, although when carefully scrutinised from time to time during the twenty-four or forty-eight hours that the parasites may continue to live, something like differentiation of an alimentary canal may be recognised.

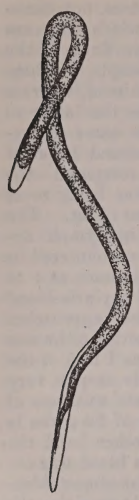

FIG. 11.
Filaria Sanguinis Hominis. × 300. (Traced from a micro-photograph.)

Microscopical Characters of the Urine.—The filaria may likewise be detected in the urine. One day it may be readily obtained in the blood but not in the urine, and *vice versâ*; but, as a rule, the parasite will be found equally readily in both fluids. In making a search in the urine, it is advisable to pick out one of the coagulated shreds generally found in it, transfer it to the glass slide by means of a forceps or pipette, and carefully tease the fragment before applying the cover-glass.

The other leading microscopical character of the urine is the minutely molecular matter—fat in an emulsified condition—to which the fluid owes its opaline or milky aspect. There are also numerous white, lymphoid corpuscles, together with red corpuscles, numerous or the reverse according to the degree of sanguinolence of the urine. Casts of the tubular structure of the kidney—indicative of organic disease of these organs—are seldom to be seen; they were absent in all the cases that have come under the writer's observation.

ANATOMICAL CHARACTERS.—The post-mortem examinations of persons who have died whilst affected with chyluria, also testify to the freedom of the kidneys from disease. This was the case in two autopsies conducted recently by Dr. McConnell in Calcutta. The writer had the opportunity of examining the kidneys of the first case, and of all the organs of the body of the other case, but could find nothing in any of the organs or tissues suggestive of being a cause of the urinary derangement, except the fact that all the vessels—arteries as well as veins—contained the filaria in their minutest ramifications. It may be further mentioned that the entozoon is present in the chylo-lymphous discharges which have already been referred to as sometimes accompanying chyluria. Of this the writer was able to satisfy himself in 1872, and repeatedly on subsequent occasions. In one of the instances the secretion flowed from the inner corner of the eye, several ounces of which escaped daily; the others were cases of elephantiasis lymphangiectodes, or nævoid elephantiasis of the scrotum. For a summary of what is known of the latter affection, the reader is referred to a carefully-written paper by Dr. Kenneth McLeod.[1]

ÆTIOLOGY AND PATHOLOGY.—Having considered in detail what seem to be the leading pathological features of chyluria, a brief reference may be made to the views which at present prevail regarding its ætiology. These may be comprised under three heads:—(1) Dr. Vandyke Carter advocates the view that a direct communication exists between the chyle-carrying vessels and the urinary tracts. (2) MM. Claude Bernard and Ch. Robin believe that the condition of the urine is but a symptom of piarrhæmia—fatty blood; the latter condition being but the normal condition of the blood for some time after the partaking of food, aggravated and made permanent by derangement of the digestive organs—notably the liver. One of these distinguished authors (M. Robin) suggests, further, that this derangement is probably induced in the liver and elsewhere by the filaria sanguinis hominis.[2] (3) The third view to be noticed is that advanced by Dr. W. Roberts. This view appears to be based mainly on the history of a very remarkable case, published by him in 1868. It was one in which a coagulable chylo-lymphous discharge escaped from open vesicles which had formed over the surface of the abdomen: the patient's urine was, moreover, chylous for two days. Dr. Roberts suggests that a condition somewhat similar to that on the surface of the abdomen existed in the urinary tract,—a sort of eczema—probably on the front of the bladder. Post-mortem examination did not however confirm this view, nor could anything be detected in any of the organs suggestive of a cause, but Dr. Roberts infers that this was probably due 'to the fact that in the last few weeks of life the morbid process had retrograded and had consequently left no appreciable marks on the surface of the bladder.' The examination of the skin in the diseased part showed that the *cutis vera* and the subcutaneous tissue were traversed by short channels or lacunæ from the width of a crow-quill to that of a hair. A careful study of this and other cases suggested to Dr. Roberts the view that one, at least, of the forms of chyluria may be due to hypertrophy of the lymphatic channels and subsequent acquisition by them of gland properties.

[1] The microscopic worms detected by the writer (in July 1874) in the blood of dogs in India—presumably the same species as those discovered by MM. Grube and Delafond, in France, about 1843—are not enclosed in an envelope of this kind, although in every other way they appear to be identical; and Dr. Sonsino states that the hæmatozoon found in Egypt is also destitute of this enveloping tube, as is likewise the urinary parasite discovered by Wucherer.

[1] *Indian Medical Gazette*, August 1874.

[2] 'Leçons sur les humeurs'; 2nd edit. 1874, p. 845.

In the present state of our knowledge, however, it cannot be said that any of these ingenious explanations meet all the objections that might be raised. For example, before the explanation suggested of the direct leakage of the chyle into the urine can be accepted as sufficient, it must be shown that such a leakage is anatomically possible, and, secondly, that the relative proportion of the leading constituents of the two fluids agree more closely than is suggested by the greater number of the analyses hitherto published. M. Robin's view does not suggest any special anatomical difficulty, but it remains to be demonstrated more conclusively than has hitherto been done that the blood in man ever contains a sufficient quantity of fatty matter to produce such extreme milkiness by admixture with the urine as is observed in chyluria. Dr. Roberts' theory is certainly not open to these particular objections, as, given a certain agent to start the formation of these glandular tissues, there does not appear to be any special anatomical or physiological difficulty to be got over; but the result of all the autopsies as yet recorded do not warrant the inference of the existence of such pathological conditions. Future observation, however, may show that they really do exist.

Of the ætiological significance of the presence of the filaria in the circulation there can, the writer thinks, scarcely be much doubt—more especially when the number of observations recorded within the short period that has elapsed since attention has been drawn to its existence therein, is taken into consideration. These suggest more than a fortuitous connection; indeed it might rather be said that chylo-serous effusions may be considered as symptomatic of the parasitism. Filariæ have even been detected shortly *before* chyluria had manifested itself. Whether they act injuriously by giving rise to rupture of the walls of the delicate channels in which they circulate and thus cause the escape of the different nutritive fluids into the urinary tract; or whether, as M. Robin suggests, they produce derangements of the liver and other organs which give rise to piarrhæmia (and, probably M. Robin would add, to rupture of the capillaries, so as to permit of the escape of the abnormally fatty blood), it would be premature to express a definite opinion. It is possible that both Carter and Robin may be correct to some extent, for the disease presents many phases; and the writer would suggest further, that it may also be possible that, in addition to giving rise to the escape of fluid in a purely mechanical manner by causing ruptures, local congestions, and so forth, the entozoon may in some way tend to the production of minute secreting structures (analogous to those described by Roberts as having been formed in the subcutaneous tissues) along the urinary tract, or in other situations, which might permit of the filtration of the ordinary nutritive fluids of the body in a more or less modified condition.—Analyses tend to show that the constituents of these fluids do not reach the urine in the proportions in which they are normally found in the body.

It is also possible that chyluria may occasionally occur unassociated with any parasite, but this remains to be demonstrated.

Prognosis.—Persons have been known to suffer off and on from this affection for from one to fifty years. This would suggest that the malady usually runs a chronic course, which as a rule it doubtless does; on the other hand patients apparently in fair health otherwise have been known to die very unexpectedly from no recognised acute disorder. With regard to the prospect of a cure a very guarded opinion should be given, as the probability is that the complaint will return again and again so long as life lasts—even when the disease commences at a very early age, and often after a complete change of climate and avocation.

Treatment.—This has proved extremely unsatisfactory in almost all the cases recorded; in fact it cannot be distinctly stated that the course of the disease has been materially modified, much less cured, by any known remedy. Iodide of potassium has been tried in large doses, and in some cases appears to have been beneficial; in others the tincture of the perchloride of iron has seemed to be more successful. A decoction of the bark of Rhizophora racemosa (mangrove) has a reputation in Guiana, just as a decoction of the seed of Nigella sativa (used also as a condiment in curries) has in India. The latter remedy has, however, been known to be powerless in mitigating the malady even in cases where on former occasions it had been resorted to with apparent success. Perhaps the most satisfactory results which have been published are those which have followed the administration of large doses of gallic acid—one or two drachms a day. *See* Filaria Sanguinis-hominis. Timothy Lewis.

CICATRIZATION (*cicatrix*, a scar) is the process by which solutions of continuity in an organ or tissue are repaired. These solutions of continuity may be due to injury, ulceration, extravasation, or the effusion of inflammatory products. The result of the process is the formation of a cicatrix or scar.

Pathology.—Cicatrization, as it occurs in superficial parts in surgical practice, may be selected as affording a typical illustration of the process. It is most frequently and easily observed, and it corresponds to what is met with in deeper tissues.

Repair may take place either with or without the occurrence of granulation, and the process of granulation may or may not be accompanied by suppuration: the existence both of granulation and of suppuration depending on the degrees of abnormal stimulation to which the injured tissues are subjected.

In an incised wound favourably circumstanced as to vascularity of tissue, absence of tension, and apposition of edges, epidermic continuity may be re-established in thirty-six to seventy-two hours. The lips of such a wound are temporarily united by a thin layer of lymph and white corpuscles of the blood, and perhaps soon afterwards by cells proliferated from connective-tissue corpuscles, These cells become spindle-shaped, and are ultimately converted into ordinary connective-tissue corpuscles, whilst offsets from the neighbouring capillaries re-establish the circulation throughout the new tissue. Coincidently with these changes the surface becomes covered with epidermic scales.

The resulting scar at first appears as a red line, which subsequently becomes white from the disappearance of many of its blood-vessels.

When an open wound heals by scabbing, the epidermis spreads over the tissues without the intervention of the process of granulation, owing to the protection afforded them by the crust of blood and lymph which has formed upon the wound.

Recent antiseptic surgery has shown that even large hollow wounds filled with blood-clot, such as are caused, say, by operation for ununited fracture of the femur, may cicatrize completely without suppuration or granulation, if protected from the stimulation of the antiseptic used. In these cases the white corpuscles of the clot become organized directly into fibro-plastic cells and connective-tissue corpuscles, and the new epidermis will probably be formed beneath a thin upper layer of the clot.

If a recent wound, too large for scabbing, be simply left exposed to the air or treated with water dressing, or with an ordinary antiseptic, there will be a discharge at first of serum tinged with blood, then of pale serum, and latterly of cloudy yellowish serum, replaced in about three days by fully-formed pus. By this time the wound will be studded over with little bright red elevations, termed granulations, which ultimately cover the whole surface. Granulation-tissue consists of nucleated cells, amongst which pass vascular loops with thin walls. After an interval the edges of the skin are seen to be on a level with the granulating surface, and as it were continuous with it. Perhaps already the wound is much smaller, owing to the shrinking of the granulations as their cells assume the spindle-cell type. Then, extending from the cutaneous margin there may be observed a narrow red line, brighter than the rest of the granulating surface, owing to the presence of a layer of transparent epidermis. Next day this zone will be bluish, owing to the growing opacity of the epidermic cells, and there will be a new red line of newest epithelium. A day later the outer layer will have become so opaque as to be whitish, and the second to be bluish; and there will again be a fresh inner red line, which will gradually advance until the scar is complete. The new epidermis quickly separates into a horny and a mucous layer.

The healing of an evacuated abscess-cavity depends partly upon the contraction, and partly upon the coalescence of the granulations of which its pyogenic membrane consists.

Many cases of disease of joints (caries, &c.), and the behaviour of abscesses treated antiseptically and with adequate drainage, may be referred to as instances of the existence of non-suppurating granulations. JOHN BISHOP.

CINCHONISM.—A condition induced by the administration of quinine, the chief active principle of cinchona. *See* QUININISM.

CINCLISIS (κιγλίζω, I move).—This word signifies agitation or motion, and was formerly applied to involuntary winking or movements of the eyelids; and also to the movements of the chest in dyspnœa.

CIRCULATION, Disorders of.—Abnormal excess and deficiency of blood are known as *Hyperæmia* and *Anæmia* respectively. Each of these may be *general* or *local*.

I. **Hyperæmia.**—*General* hyperæmia signifies excess of blood in the body, and is also called *plethora*. *Local* hyperæmia means excess of blood in a part. Such excess may be caused either by superabundant supply, or by deficient removal of blood through the agency of the blood-vessels. Dilatation of the arteries, however produced, causes more copious afflux of blood, which fills the capillaries and veins in a corresponding degree, so that there is excess of blood in all the vessels of the part. This condition is called *arterial* or *active hyperæmia*, *active congestion*, or *determination of blood*. If, on the other hand, blood is imperfectly removed by the veins, these vessels, as well as the capillaries, become gorged, and the condition called *venous* or *passive hyperæmia*, or *venous congestion*, results. There cannot be *capillary hyperæmia*, except as the result of one of these conditions.

A. *Arterial or Active Hyperæmia.*—An excessive amount of blood can be conveyed by the arteries only under two conditions:—(1) Enlargement of these vessels by relaxation of their muscular walls; (2) Increased pressure within them, from obstruction of collateral channels with which they communicate, *i.e.* collateral hyperæmia.

(1) Relaxation of the muscular walls may be caused *directly* by violence or by warmth, as is illustrated in the redness of the skin produced by a blow, by heat, or by the reaction after intense cold. Sudden withdrawal of pressure has the same effect, as is sometimes seen on evacuating a hydrocele or fluid-collection in a serous cavity. Dry-cupping produces similar but more complex results, the veins being acted upon as much as the arteries. Relaxation of the muscle-fibres is produced also *indirectly* through the vaso-motor nerves. If these are paralysed, relaxation of the fibres occurs, and the arteries dilate. Experimental section of the cervical sympathetic in animals shows this most clearly; but the same result follows less constantly if other nerves containing vaso-motor fibres are divided or injured, such as the mixed nerves of the limbs, or branches of the trigeminus. Wounds of the brachial plexus have been found to cause hyperæmia of the fingers (*glossy fingers* of Paget). When the section is complete, hyperæmia is only transitory, and is soon followed by a return to the normal condition, or even by undue anæmia, which is permanent. In irritative lesions, on the other hand, such as gunshot wounds, hyperæmia continues as long as the irritation. In such cases it is possible that the lesion is not paralytic, but depends upon stimulation of the actively-dilating vaso-motor fibres which physiologists have now shown to exist in many parts of the body, since stimulation of these produces the same result as paralysis of the inhibitory fibres. Hyperæmia often accompanies neuralgia, both depending upon some morbid condition of the nerve. The starting point of the neurosis in all these cases may be, and often is, in the central nervous system, and hence chronic diseases of the spinal cord or brain are often accompanied by general

paralytic hyperæmia—that is, flushing, or by congestion of special parts. The same result may come from reflex nervous action, set up by disturbances of the digestive organs, the organs of generation, or of other parts.

(2) Collateral hyperæmia is a consequence of the rise of pressure produced by the blocking-up of arterial channels in the adjoining parts. It is usually effected by the enlargement of existing vessels, and the conversion of small, almost capillary, vessels into pulsating arteries. It occurs not only in the familiar instances of surgical ligature, and the sudden blocking of an artery by a plug (*see* Embolism); but in the gradual obstruction which accompanies atrophic and sclerotic processes. When the chief arterial channels to an organ become obstructed, its peripheral parts are very liable to become hyperæmic, a principle which when applied to such cases as cirrhosis of the liver, granular kidney, and sclerosis of the brain, will be found fruitful in practical deductions.

Signs and Results.—The colour of parts in a state of active hyperæmia is, during life, bright red, the arteries, large and small, being visibly injected, while the capillaries, filled with arterial blood, produce a diffuse red colour. In experimental hyperæmia the blood may remain bright red even in the veins. The temperature of external parts becomes elevated, though not above that of internal parts. Sometimes there is obvious pulsation or throbbing. There may be swelling, which is due to simple enlargement of the vessels, not to exudation of fluid, since this does not occur from arterial hyperæmia alone. The nerves, both those of common sensation and those of special sense, are more excitable than they are normally. There is usually a subjective sensation of warmth, and there may be pain or itching.

Arterial hyperæmia may last for a long time without producing any change whatever in the part affected, but may, under conditions little understood, give rise to hypertrophy, which sometimes, though rarely, results from section of the cervical sympathetic. Transitory but repeated hyperæmic conditions more regularly produce this result, as is seen in hypertrophy from pressure; in thickening of the skull from excessive exposure of the head to the sun; in hypertrophy of the skin and its glands from frequently recurring hyperæmia of the face (*acne rosacea*). This kind of hyperæmia constantly precedes, but can hardly be said to produce, inflammation. It does, however, render the tissues more vulnerable, bringing them into a condition in which a slight cause will set up inflammation. Unless the vessels are unsound, simple arterial hyperæmia does not lead to hæmorrhage.

B. *Passive Hyperæmia or Venous Congestion.*—This may be due to —(1) Feeble circulation; or (2) Obstruction in the veins.

(1) Blood may be imperfectly removed from a part, owing to the imperfect action of the forces which normally maintain the flow of blood in the veins. These are, besides the action of the heart, the pressure of muscles (combined with the arrangement of the valves in the veins), and the movement of the thorax in inspiration. If these are deficient, the venous current will be everywhere delayed, but notably in those parts where it has to overcome the action of gravity. In the erect posture this will be the case in the lower limbs, and hence venous congestion is common in the legs, ankles, and feet. In decumbent patients, for analogous reasons, the nates, sacrum, shoulder-blades, and the bases of the lungs behind become the seat of what is called *hypostatic congestion*. Very general obstruction, such as results from imperfection of the heart itself, may lead to the condition called cyanosis, which is essentially venous congestion, and to similar congestion of the lungs, liver, kidneys, and other internal organs, with very serious results.

(2) Obstruction of the veins is rarely produced by a morbid condition of the walls of these vessels, but may result from coagulation of blood within them. Another cause is external pressure, such as that of tumours, of the gravid uterus, or of the intestinal contents, as in the case of the hæmorrhoidal veins. Finally, indurative changes in the solid viscera lead to venous obstruction, as is seen in cirrhosis of the liver, which produces congestion of the whole portal system.

Signs and Results.—The colour of parts in a state of passive hyperæmia is bluish rather than red, the veins, large and small, being injected with venous blood, and the capillaries, in which the blood is also venous, producing a uniform purple colour. If the congestion is extreme, collateral venous channels are likely to be established, which are sometimes the only evident sign of internal venous obstruction. The surface is usually cooler rather than hotter when compared with corresponding parts of the body; and there is no unusual nervous sensibility or sense of throbbing. Swelling very frequently occurs, and depends on actual serous effusion from the vessels, so that the parts are often anasarcous, pitting on pressure; while in cavities there is an accumulation of fluid.

Venous congestion produces more important and permanent results than arterial. In experimental venous obstruction, besides engorgement of the vessels, two nearly constant phenomena are seen—copious transudation of serum, and migration of a number of red blood-disks through the walls of the capillaries and smaller veins. Few or no white corpuscles emigrate, and the arterial circulation is unaltered. The absence or occurrence of dropsy depends upon the adequacy or inadequacy of the lymphatics to carry off the superfluous serum. In ordinary pathological venous congestion all these changes are seen to some extent; extravasation of red blood-disks being shown by the pigmentation of parts in chronic congestion, though this is not evident in the acute condition. Chronic venous congestion increases the hardness and density of organs, a change which may, in the first instance, result from simple œdema, but in the end is due to fibroid change (*see* Degenerations). Such organs are at first enlarged, but ultimately diminish in size, and suffer fatty atrophy, not only through the general law of fibroid change, but because venous blood is inadequate to the proper nutrition of tissues. These changes are seen in the liver and kidneys in cases of obstructive heart-disease. External parts, as the skin of the lower part of the leg, show by a tendency

to ulceration that they are imperfectly nourished, and are also liable to become inflamed from slight causes (varicose eczema).

Post-mortem Characters.—The appearance of hyperæmic parts after death is not necessarily the same as during life. The colour of the blood does not enable us to say whether the hyperæmia was arterial or venous. All blood contained in the body after death, excluded from the air, is dark or venous, but becomes florid when exposed to the air, unless it have previously undergone some *post-mortem* change, or some morbid alteration during life. This change may be watched in the lungs when the chest is opened, especially in the case of children whose lungs have little local colour. The only important point after death is the fulness of the three kinds of vessels. Arteries are usually empty, unless diseased; the larger veins almost always full. If the smaller veins and arteries are conspicuously and brightly injected, the part may be described simply as congested; a uniform colour indicates fulness of the capillaries, which may be confirmed by the microscope. Uncomplicated arterial hyperæmia leaves no trace after death; the appearance of it is produced by inflammation. Simple venous hyperæmia can only be recognised as such after death by comparison, that is, with the same part under normal conditions. Chronic venous congestion is indicated by many of the same characters as during life. Care should be taken not to mistake for arterial hyperæmia mere staining with blood-pigment of the walls of the vessels; nor for venous congestion mere *post-mortem* hypostasis, or the settling down of the blood, if fluid, after death.

II. Anæmia.—*General* anæmia is a morbid condition in which there is a deficiency of blood, or, more correctly, a deficiency of the red corpuscles of the blood, throughout the whole body. It is also called *oligæmia*, or *oligocythæmia* (*see* Anæmia). *Local* anæmia, with which we are here concerned, signifies deficiency of blood in a part. It may be complete or partial. Complete local anæmia can only occur when the blood-supply of a part is totally cut off by obstruction of its arteries. The conditions and consequences of such obstruction are discussed elsewhere (*see* Embolism.) Partial anæmia or *ischæmia* may be produced by direct pressure, or else by arterial obstruction, permanent or transitory. Permanent anæmia of many parts results from gradual obstruction of arteries by atheromatous change, or, still more strikingly, by a form of endarteritis (*endarteritis obliterans*) attributed to syphilis; or, again, from deposition of fibrin on the diseased vascular wall. Temporary anæmia results from spasmodic contraction of the annular fibre-cells in the muscular coat of the artery. Such a contraction may be produced experimentally by direct electrical stimulation, or by stimulation of the sympathetic branches distributed to the vessel; and in pathological conditions we find such contraction occurring in consequence of some derangement of the nerve-centres, or from reflex irritation, or even, as it would seem, idiopathically. Neuralgia and migraine are often accompanied or caused by spasm of the arteries, and epilepsy has, with less certainty, been attributed to the same cause. In these cases it is possible, as is held by some authorities, that anæmia of the nerve-tissue is the cause of the disturbed innervation. Hysterical blindness, and probably other hysterical affections, may be explained in the same way.

Signs and Results.—An anæmic part is pale, its temperature in the case of external parts is diminished, and there is weakened or arrested arterial pulsation. A permanent condition of anæmia, even if only partial, produces degeneration, ending in atrophy of the affected part. The wasting of the skin, and possibly that of the kidneys in old age, is due to this cause. Transitory anæmia causes necessarily a cessation of functional activity in the part, as is obvious in the nerve-centres and the muscles; but does not, so far as we know, produce any permanent change. Compression or obstruction of the abdominal aorta produces symptoms of temporary paraplegia. J. F. Payne.

CIRCULATION, Diseases of Organs of. The organs of circulation comprehend the heart, the arteries, the veins, and the intervening capillaries. The diseases affecting each of these structures will be found described under their respective headings. It has, however, been thought desirable to give in this place a general sketch of the different ways in which the intimate relations that exist between the parts of the circulatory apparatus may be disturbed by disease. While the heart, the arteries, the veins, and the capillaries have each special diseases, related to their differences of structure and of function, the effect of such diseases is rarely or never purely local. The other parts of the circulation on either side of the lesion and the regions to which the vessels are distributed suffer more or less from the local disease. This is true whether the disease be structural or only functional; and whether, in the latter case, the nervous system or the blood be the primary seat of the disorder. Viewed thus, the subject will be best considered under three heads:—1. The *structural changes* of the several organs of circulation, and the diseases and disorders to which they give rise in other parts of the system, whether general or local. 2. The *functional disorders* of the organs of circulation due to *nervous* disturbance, both local and general. 3. The *functional disorders* of the circulation due to changes in the *blood*. We shall discuss these divisions in the order in which they have been named.

(A)—Structural Changes in the Organs of Circulation.—The *heart* is liable to organic disease either in its propelling muscular walls, its regulating valves, or its controlling nervous system; and it will be found that diseases of each of these parts of the cardiac apparatus affect respectively its several functions. Thus disease of the walls of the heart affects the force or pressure; valvular disease primarily disturbs the distribution or quantity of blood in the several parts of the circulation; while nervous disorder especially interferes with the rate and regularity of its movements. Diseases of the *arteries* interfere with the quantity of blood transmitted through them, and produce secondary disturbances of distribution or of pressure. When the *capillary* walls are degenerated or ruptured, or when their canals

are blocked as a result of embolism or thrombosis in arteries or veins, nutrition is disturbed in various ways. Lastly, the *veins* may be the seat of a variety of lesions, which prevent the return of blood, and lead to hæmorrhage or to dropsy. We shall consider the diseases that have been above indicated from a common point of view, viz. their effects upon the circulation.

1. The *pressure* of blood within the circulation may be either increased, diminished, or irregularly distributed. The most marked instance of *increased* pressure is seen in simple hypertrophy of the left ventricle without valvular disease, especially if the hypertrophy be associated with increased peripheral resistance, as observed in chronic Bright's disease. The effects of increased pressure on the *heart* are cardiac enlargement with its consequences, and valvular disease; in the *arteries*, they are fulness, elongation, thickening, and atheroma with its results. The *pulse* is strong and full, and may possess the various characters of the vessel-wall just enumerated. The *capillaries* are over-distended, and may be ruptured, hæmorrhage being the result. The functions of the several organs are, under favourable circumstances, more active; and the *venous* circulation is more free.

Diminished pressure of the circulation is more common, and is seen in dilatation with thinning of the cardiac walls, in atrophy, in fatty degeneration, and in fibroid hypertrophy or degeneration. The effects of diminished pressure within the circulation generally are the reverse of those of increased pressure. The *arteries* are comparatively empty and small, and the pulse is weak, small, and often irregular. The *capillaries* are insufficiently supplied with blood; the visible surfaces are anæmic, or passively congested; and the various functions are feebly discharged. The backward pressure within the *veins* is, on the contrary, increased; the blood tends to accumulate within them; the walls are dilated; the valves are disorganised; and passive congestion, thrombosis, dropsy, and chronic inflammation are frequent results.

2. *The Quantity of blood distributed.*—What has just been said concerning the pressure of the blood applies, in a great measure, to the quantity distributed through the circulatory system. In hypertrophy of the heart, a larger amount of blood passes through it in a given time, and the arteries and pulse are full; while in atrophy and dilatation the quantity is less, and the pulse is empty and contracted.

3. The most frequent disturbance observed is *irregularity of distribution.* This condition generally affects the pressure and quantity together, but may affect one more than the other. Irregular distribution of blood and of pressure is most markedly present in valvular imperfection, and especially in aortic and mitral regurgitation. It is also seen in obstruction and other allied conditions of the arteries, especially of the aorta. In the parts of the circulation and in the organs situated behind the seat of disease, irregularity of distribution of blood and of pressure is manifested in the form of dilatation, such as enlargement and engorgement of the heart, of congestion and associated changes in the lungs and abdominal viscera, of hæmorrhage, and of various exudations and effusions whether as œdema, dropsy, or catarrh. On the other hand, the portions of the circulatory apparatus beyond the seat of disease are underfilled and undersized; the organs are deprived of their sufficient supply of blood: and anæmia, with its further consequences, is the result.

4. *Frequency and Rhythm.*—Among the most common forms of cardiac disturbance are alteration of frequency and irregularity of rhythm. Alteration in frequency is generally in the direction of increase; but unnatural slowing may also occur as a symptom of fatty degeneration and other morbid conditions. The essential causes of modifications in the rate of the heart's action are very complex and obscure, for the muscular tissue, the intrinsic nervous apparatus, and the extra-cardiac nerves and centre in the medulla oblongata, may, in different instances, be all more or less concerned. As a rule, increased frequency is associated with, and proportionate to, weakness of ventricular contraction. Unnatural slowing is believed to be generally nervous in its origin; but it may sometimes be due to inertness of the muscular substance from fatty degeneration of the walls of the heart. The remarks that have just been made respecting frequency apply equally to disturbance of rhythm and irregularity of contraction. Frequency and irregularity of pulse in organic disease of the heart are generally indications of serious cardiac weakness, and are often found in the later stages of heart-disease, whether its original seat has been valvular or parietal.

(B.) Functional Nervous Disorders of the Circulation.—When the distribution and functions of the nervous structures associated with the organs of circulation are considered, the variety and complexity of the disorders of the heart and vessels due to nervous influences will be readily appreciated.

Through the medium of the nervous system the action of the heart is affected by every sensory impression received by the brain; specially by influences proceeding from the following parts:—the respiratory centre, the respiratory organs, the blood-vessels, the abdominal viscera, the surface of the body, and the cerebrum itself with the organs of sense. Many of the disturbances of the circulation with which the reader is familiar in diseases of the *lungs* are occasioned through nervous channels, especially such respiratory diseases as are attended with imperfect oxygenation of the blood. In the *blood-vessels*, the most marked example of nervous association between them and the heart is afforded by the relaxation of the arteries in cardiac over-distension and embarrassment through the operation of the depressor nerve, which, passing from the heart to the vaso-motor centre in the medulla, inhibits or controls the constricting influences constantly exerted by this centre on the walls of the vessels, and thus effects the relaxation of these vessels and 'depresses' the circulation or lowers the blood-pressure. Cardiac disturbance referable to *abdominal* causes is so familiar that it needs scarcely to be mentioned; and such disturbance, though frequently direct, is more frequently indirect or reflex through the nervous centres. The

condition of the blood-vessels within the abdomen has the greatest influence on the heart and circulation generally, as may be seen in cases of shock, injury, and inflammation of the peritoneum and great viscera. The *surface* of the body, as the seat of impressions of touch, of temperature, and of common sensibility, may prove to be the source of cardio-vascular nervous disturbance. It is through impressions on the nerves of the surface that the circulation may be disturbed until seriously embarrassed, and even paralysed, as in shock, exposure to cold, &c.; or, on the other hand, roused to activity, by blistering, flagellation, douching, &c. Lastly, the more extreme and frequent, as well as the more irregular and varied nervous disturbances of the circulatory organs are due to conditions of the *brain*. The most common of all forms of circulatory disturbance is seen in emotional excitement, as palpitation, with vascular throbbing, and as in blushing or in pallor.

The general phenomena of functional disorders of the circulation due to nervous disturbance are—(1) Alteration in the force, frequency, and rhythm of the cardiac movements; and (2) Disturbances of sensibility referable to the condition of the nerves, to distension of the cavities, and to irregular muscular contraction. In certain cases the cardio-vascular disorder may be extensive, complex, and serious, and may involve the neighbouring nerves, as is seen in angina pectoris. The remote effects of those attacks of functional failure are fully described elsewhere. *See* HEART, Functional Disorders of. Other disorders of a complex character occur, such as Graves's disease, which is probably referable to a nervous origin.

(C.) FUNCTIONAL DISORDERS OF THE CIRCULATION, DEPENDING ON THE CONDITION OF THE BLOOD.—The blood is so essentially associated with the organs of circulation, that any alteration either in its quantity or in its composition speedily manifests itself in disorders of the heart or vessels. Besides the effect on the general intravascular pressure that follows directly any change in the blood, there are two ways in which any morbid state of this fluid reacts upon the circulation—namely, first, by affecting the nutrition of the cardiac and vascular walls; and, secondly, through the agency of the nervous centres. Thus, when the *amount* of blood is below the normal, not only is the circulation comparatively depressed, but the tone of the myocardium is ill-nourished and feeble, the tone of the vessels is low, and the excitability of the nervous centres, which directly or indirectly control the heart, is greatly increased. The opposite condition—of plethora, high blood-pressure, enlarged and powerful heart, and energetic nervous system cannot, within definite limits, be considered morbid, but rather an evidence of too robust health. The most frequent changes in the *quality* of the blood are those which are associated with anæmia, as first described. The next most important group of cases is that in which the blood contains some poison, whether generated within the body or introduced from without. The disturbances of the circulation by poisons of all kinds are very numerous and complex. When the poisoning of the blood is of long duration, and moderate in degree, chronic disease may be set up throughout the organs of circulation; and this is probably the mode of origin of the cardio-vascular disease so often found accompanying chronic Bright's disease.

R. QUAIN, M.D.

CIRRHOSIS (κιρρός, yellow).—SYNON.: Sclerosis; Fibroid Substitution; Fibroid Degeneration; Chronic Interstitial Inflammation; Fr. *Cirrhose*; Ger. *Cirrhose*.

The term cirrhosis, which was originally invented to describe a particular state of the liver has now acquired a more extended meaning, and is applied to similar morbid processes affecting other organs, though the name itself, derived as it is from the yellow colour of the liver in this disease, ceases to be properly applicable. Cirrhosis may be regarded as a chronic non-suppurative inflammation affecting the interstitial, connective, and supporting tissues of the different organs, and not those by which the proper physiological function is performed. The process begins, after a more or less protracted hyperæmia, by the appearance in the interstitial tissues, between the proper functional elements, of small lymphoid corpuscles or leucocytes, which are arranged in lines or tracts interpenetrating the affected organ. These corpuscles crowd the tunica adventitia of the small vessels, the lymph-spaces, and the cavities in which the connective-tissue corpuscles lie; and when present in considerable amount appear to the naked eye as narrow lines of a slightly translucent greyish material. This condition was formerly termed cellular hyperplasia of the connective tissue, and the corpuscles themselves were supposed to originate from proliferation of the connective-tissue corpuscles. More recent researches have, however, shown that in inflammation the connective-tissue corpuscles remain quite passive and take no part in the formation of new cells. The early stage of cirrhosis is therefore more correctly described as cellular infiltration of the connective tissue. The cells themselves are white blood-globules, which have emigrated from the vessels, and their descendants. The amount of this cellular exudation varies very much in different organs in the different forms of the disease. In many cases of cirrhosis of the liver, and in the fibroid induration of the left ventricle of the heart, and of the pylorus, it is very considerable, and causes much increase in the bulk of the affected organ. In other instances, as in some forms of granular kidney, it may be very small. Many pathologists consequently regard the process in these cases as essentially one of atrophy of the true physiological tissue, and the indurated fibrous tissue which results as consisting of the withered remains of the vessels ducts, &c. of the organ.

The later stages of the process consist in the conversion of these tracts, which may be looked upon as closely analogous to ordinary granulation-tissue, into fibrous tissue. A more or less fibrillated intercellular substance appears; the corpuscles diminish in number; the remaining ones become in part elongated and oar-shaped, and some may pass into true spindle-cells, or

become stellate: in cirrhosis of the lung tracts of true spindle-cell tissue are often met with. In the liver, where much of this new tissue is often formed, numerous blood-vessels become developed in it: they are devoid of distinct walls and consist merely of channels lined by endothelium. The fibrous tissue which is the final result of the whole process, closely resembles ordinary cicatricial tissue; it is usually tough, dense, and imperfectly fibrillated, with a strong tendency to contract. Sometimes, especially in the suprarenal capsules, and less frequently in the liver, portions of it consist of a reticulated connective tissue.

The *effect* of this series of changes on the proper physiological tissue of the organ is to cause its atrophy. This is partly due to the direct pressure of the new growth, when it is formed in large quantities, but chiefly to the constriction of the contracting fibrous tissue and the consequent obliteration of the blood-vessels; for even where, as in the liver, new vessels are developed, the original vessels of the organ become obliterated. The atrophy of the proper tissue of the organs appears to take place by a gradual process of granular and fatty degeneration followed by absorption. Sometimes, particularly in the lungs and suprarenal capsules, this change is less gradual, and portions of the original tissue together with the new growth lose their vitality *en masse*, pass at once into a state of fatty degeneration, and ultimately become caseous and even calcareous, giving rise to the formation of opaque yellow nodules surrounded by the semi-translucent grey fibrous tracts. In these cases it becomes difficult to draw a strict line of demarcation between cirrhosis and true tuberculosis, and the difficulty is rendered greater from the fact that chronic tuberculosis in itself sets up the cirrhotic process. In the lung the caseous transformation is no doubt most commonly caused by the filling up of the air-vesicles with large epithelioid catarrhal cells coincidently with the cirrhotic change in the walls of the vessels. These catarrhal cells not being in immediate relation with the blood-vessels, are especially prone to caseous change. So, too, in the suprarenal capsules the caseous nodules, if examined early enough, will be found to consist of the tubular spaces of the organ filled with their cells in a state of fatty degeneration. In the liver, on the other hand, the secretory cells, being in intimate relation with the blood-vessels, are not liable to this caseous transformation. Again, it is impossible to make a strict demarcation between syphilitic affections of the viscera and true cirrhosis. Even the typical gummata of syphilis originate in and are surrounded by tracts of cirrhotic induration; and in other cases where true gummata are not found, the only difference between cirrhosis and syphilis is that in the latter there is a greater accumulation of the new growth at particular points and a less general diffusion of it through the organ. Lastly, in some cases, as in the cirrhotic liver of hereditary syphilis, the two processes are identical.

If we now proceed to inquire into the *causes* of cirrhosis, we find that it is generally preceded by a protracted hyperæmia of the affected organ produced by some chronic irritation, whether functional or mechanical. As examples of this may be mentioned cirrhosis of the liver which results from the congestion produced by spirit-drinking; sclerosis of the grey matter of the cerebral convolutions after protracted maniacal excitement; cirrhosis of the lung, the result of prolonged inhalation of irritating dust in the various forms of grinders' and miners' phthisis; the cirrhotic thickening of the pylorus in chronic catarrh of the stomach; and cirrhotic affections of the lungs and heart extending to those organs in chronic inflammation of their serous coverings. A mere passive congestion, however, if long continued, may cause a simple hypertrophy or overgrowth of the interstitial connective tissue, and more or less induration in consequence. It does not, however, appear to have the same tendency to excite active proliferation and the formation of the contracting fibrous tissue characteristic of true cirrhosis. The exception to this rule is that we usually meet with a slight degree of the cirrhotic change in cases of 'nutmeg' atrophy of the liver due to prolonged passive congestion of the hepatic venous system. W. Cayley.

CIRRHOSIS OF LIVER, LUNG, &c. *See* Liver, Lung, &c., Diseases of.

CIVIL INCAPACITY.—One of the causes of this condition is mental weakness or disease, and it is one of the duties of the physician to aid in determining the existence and nature of such conditions. There is a kind of incapacity which is implied in the restriction of a person's liberty when he is placed under care in an asylum or other special place of treatment. The necessary information regarding this will be found in the article Lunacy, Laws of. But the question of incapacity is more directly raised when it is proposed that a person should be declared unfit to exercise his civil rights, to require the shield of the law to prevent his being imposed on, and to obtain special protection for his property. Medical evidence will require to be taken if it becomes necessary for a Commission of Lunacy to be issued by the Lord Chancellor. This is a proceeding which ought not to be adopted if it can properly be avoided. But it must be remembered that till a person is found lunatic by inquisition he may, though placed in an asylum under regular certificates, exercise his rights unrestricted in the disposal of his property. The acts of any person either in or out of an asylum may, however, be declared invalid if it can be shown that at the time they were performed the person laboured under such an insanity as rendered him incapable of performing them rationally and without injurious consequences. On this principle any person may be found to have been incapable of contracting marriage, of executing a deed, contracting a debt, making a will, or giving credible evidence. The principle, it must be carefully noted, is not that the mere existence of insanity in the person performing them invalidates such actions, but that if the insanity has materially affected the character and quality of the actions they may be thereby invalidated. This is one of the most important principles that a medical jurist has to keep in mind as it is not an unfrequent mistake to sup-

pose that a person is necessarily incapacitated for the performance of every civil act the moment he can be proved to labour under any condition to which the term insanity may be applied. Perhaps the case in which the validity of a civil act is most easily endangered by the existence of any form of insanity is the contract of marriage. This proceeding is supposed so to affect the whole relations of life that almost any form of unsoundness of mind may be sufficient to interfere with that intelligent and deliberate consideration which is essential to the giving of rational consent.

The different kinds of mental disease will be found described elsewhere (*see* INSANITY), and it is necessary that the practitioner, when dealing with medico-legal questions, should be fully acquainted with them. But it is chiefly important that he should distinguish the two following classes: (1) diseased perversion of the mental faculties, and (2) weakness or enfeeblement of the mental faculties resulting either from defective development, disease, or decay. The first class includes all kinds of insanity which are the result of active disease. These would be the simple forms of delirium, mania, melancholia, and monomania; as well as the similar primary conditions which are found in general paralysis, and other diseases which present maniacal, melancholic, or monomaniacal symptoms. It is in this class that the special knowledge of the physician can be most successfully applied in aiding the administration of justice. In order to establish the incapacity of a person said to labour under any of these forms of disease, it must be necessary that an experienced physician should not only be able to detect their characteristic symptoms, but also to show that the performance of the duties or the exercise of the rights under consideration would be modified or obstructed by the existence of such disease. The second class includes congenital imbecility, and all the forms of what is called chronic dementia—all those enfeeblements of mind which are sometimes the remaining effects of acute disease, sometimes the concomitants of chronic disease, and sometimes only the mental phase of senile decay. Here, again, the information which may be communicated by the physician must be of great importance. But in estimating the extent to which a condition of mere mental weakness will disable a person from the performance of a certain class of actions there is not so much special medical knowledge required as is necessary in the consideration of active disease.

Marriage.—As has been already stated, the mere existence of any form of insanity in one of the parties may render a contract of marriage void. In one case which terminated in this manner, a man who had been insane and when in that state had voluntarily contracted marriage instituted the suit himself.

Civil Contracts may be held binding although made by lunatics. If the person with whom a contract is made had no knowledge that the person contracting was insane, and if no attempt was made to take undue advantage of him, the contract would be held good.

Wills.—A person is considered to be of a disposing mind, that is, capable of making a valid will, if he knows the nature of the act which he is performing, and is fully aware of its consequences. It is in regard to the making of wills that the law has carried out most thoroughly the principle that the validity of an act ought to be maintained in cases of insanity unless at the time the act is performed the state of mind of the agent can be shown to render him unfit to perform that particular act in a rational manner. Persons have made valid wills while inmates of lunatic asylums. And one will was held to be good though the testator had committed suicide within three days after its execution. The existence of delusion which has been regarded by lawyers as of such importance in cases of alleged insanity does not invalidate a will; for it has been declared to be 'compatible with the retention of the general powers of the faculties of the mind,' and to be 'insufficient to overthrow the will unless it was calculated to influence the testator in making it.' On the other hand, a will may be invalidated on account of the existence of mental states which would not be regarded as insanity from either a legal or medical point of view. Drowsiness and stupor resulting from erysipelas or fever, extreme weakness from cholera, and failure of memory in old age, have all been found sufficient to render wills void. It frequently happens that a medical man is called on to be witness to a will. On such an occasion it is his duty to satisfy himself as to the testamentary capacity of the testator. His subsequent evidence in regard to this, will, in case of dispute, be of almost decisive influence if he has taken proper means of forming an opinion. In all cases, therefore, where there may be a possibility of doubt it is well to require the testator to show that without extraneous aid, and without referring to the document itself, he remembers and understands all the provisions of the deed.

Evidence of the Insane.—Lunacy was, till a recent date, regarded by the law as incapacitating a patient from giving evidence in court. But according to the much more extended signification which the term lunacy has received it now includes states of mind which are looked on as compatible with testimonial capacity. Where the judge is satisfied that the lunatic understands the obligation of an oath, and can give a rational account of such things as happen before his eyes, the evidence may be admitted. But the weight to be attached to such evidence will still depend on the extent to which it fulfils the conditions commonly required to constitute credibility. It has been held, however, that when a person has suffered from an attack of insanity between the occurrence of the transaction and the time he tenders his testimony, his evidence cannot be admitted.

Management of Property.—Where persons are supposed to be unable from unsoundness of mind to undertake the management of their own property, it may be necessary that they should be placed under the protection of the Court of Chancery; but this proceeding is not usually had recourse to unless there is urgent necessity or a strong probability that the person's incapacity will be permanent. It is consequently resorted to chiefly in chronic or congenital cases where

there is no room for doubt as to the mental condition of the individual; and in cases of recent insanity where it is necessary to have recourse to an asylum for the protection of the individual it may also be necessary to obtain protection for his property by the aid of the Court of Chancery. In giving evidence or framing a statement in such a case it is important, if incapacity is to be proved, to show that the individual has been found, when placed in circumstances requiring such capacity, unable to perform the acts which the management of property necessitates. In cases of active insanity it is especially required to show, not merely that there is delusion or other symptoms of insanity, but that the insanity is of such a nature as specially to disable the person from duly performing the duties which would be required of him. Difficulties most frequently occur in cases of imbecility and dementia; but the verdicts in such cases when disputed will generally be found to rest rather upon the impression produced by evidence of the actual behaviour of the individual than upon the mere medical view of his mental condition. The most effectual aid that the medical witness can render in such cases is to show whether there are or are not such peculiarities in the conduct of the person under inquisition as are known to be characteristic of imbeciles or demented persons. In undisputed cases, where the duty of the medical man consists merely in making an affidavit, there is no special difficulty to be encountered. Brevity, scrupulous accuracy, and attention to the fact that such unsoundness of mind as involves incompetency to manage property must be established, are the most important requirements. A person found by the court to be incapable is placed under the control of a 'committee of the person,' and the property under a 'committee of the estate.' In Scotland an application to the Court of Session for the appointment of a *Curator bonis* takes the place of the English inquisition. The chief peculiarities of the Scotch process are that it is cheaper, more easily effected and more easily annulled, and that it does not affect the person of the lunatic. The functions of the curator correspond to those of the committee of the estate in the English court. The Scotch procedure for the appointment of a guardian of the person was virtually in desuetude until the passing of a recent statute (31 and 32 Vict., cap. 100). Under this act a brieve for the cognition of an alleged lunatic is issued from Chancery and tried before a judge of the Court of Session and a special jury. The procedure is similar to that of jury trials in other civil causes in Scotland, and both medical and other evidence must be produced. If the person so cognosced be found 'furious, fatuous, or labouring under such unsoundness of mind as to render him incapable of managing his affairs,' his person is placed under the guardianship of the nearest male relative found competent.

Drunkenness.—This condition is not held to deprive a man of civil capacity unless it has at the time rendered the individual unconscious of what he was doing. J. SIBBALD.

CLAP.—A popular name for gonorrhœa. *See* GONORRHŒA.

CLAVUS HYSTERICUS (*clavus*, a nail).—An acute pain often associated with hysteria, but occurring also in other conditions, which is felt in a localised point in the head, and is compared by the sufferer to the sensation that might be produced by a nail being driven into the part. *See* HYSTERIA.

CLIMACTERIC (κλιμακτὴρ, a step, κλιμάζω, I proceed by degrees, or step by step).—This word, which properly signifies 'by degrees,' was originally employed to indicate certain epochs or periods in the life of an individual, which were looked upon as critical, and at which the body was supposed to have undergone a complete change, so that it had become entirely renewed in its structural elements. The years in which these epochs terminated were called climacteric years—*anni climacterici*, and their number was variously estimated. Thus, some only recognised three climacterics; the Greek physiologists held that there were five, ending at the seventh year, the twenty-first (7×3), the forty-ninth (7×7), the sixty-third (7×9), and the eighty-first (9×9); others made them multiples of seven or nine, or multiples of seven by an odd number. Most regarded the sixty-third year as the *grand climacteric*, but the Greeks recognised two grand climacterics, terminating respectively at the sixty-third and eighty-first years, and this special denomination was given because there was little, if any, prospect of life being extended beyond these periods. At the present day the word climacteric has lost much of its original meaning, and is generally applied to certain times of life, without any reference to numbers of years, at which marked physiological or developmental changes occur, such as the period of puberty, or that of the cessation of menstruation.

A particular *climacteric disease* has been described, which is said to occur either about or subsequent to the sixty-third year or grand climacteric, and supposed to be distinct from the natural decay and degeneration which takes place in advanced life, inasmuch as recovery often ensues. It is stated that the complaint comes on suddenly, but advances insidiously, the symptoms being at first loss of flesh and weakness, followed by loss of appetite and dyspeptic symptoms with a white tongue, which are regarded as sympathetic, sleeplessness or disturbed and unrefreshing sleep, constipation, pains in the head and chest, a frequent pulse, swelling of the legs, and an emaciated or bloated appearance of the face. The urine does not present any abnormal characters, and most of the viscera seem to perform their functions properly. Whether there is any independent disease deserving this special denomination seems to the writer to be more than doubtful.

FREDERICK T. ROBERTS.

CLIMATE, Ætiology of. *See* DISEASE, Causes of.

CLIMATE.—Formerly the word climate (from the Greek word κλίνω, I incline) was a term of astronomical or mathematical geography, which implied a portion or zone of the earth's surface comprised between two lines parallel to the equator, and measured by the length of time during which the sun there appears during the

summer solstice, that is, by the sun's inclination. The space between the equator and the pole was divided into half-hour climates, in which the length of each day increased by half-an-hour, and also into monthly climates. This unequal division of each hemisphere is now replaced by a division of the interval between the equator and the poles into ninety degrees, which constitute what are called degrees of latitude, and the word climate has received a more extended application.

By climate is now understood those conditions of heat, moisture, atmosphere, wind, soil, and electricity, which impress certain conditions, uniform even when apparently irregular, on given portions of the earth's surface, and which modify, also in a uniform manner, vegetable and animal life.

Climate, when thus interpreted, is still principally dependent on astronomical facts, on the sun's position or inclination with regard to the earth, and on the amount of heat it supplies to different portions of the surface of the latter. Climate may be studied generally and locally. The division of the earth's climates is necessarily arbitrary, and many different classifications have been proposed. The most simple is that which recognises three principal kinds of climate, each susceptible of subdivision, viz.: warm climates from the equator to 35° lat., temperate climates from 35° to 50° or 55° lat., cold climates from 50° or 55° to the pole. As subdivisions we may recognise equatorial, tropical, sub-tropical, subpolar, and polar climates; and also insular and maritime, or moist climates—continental and mountain, or dry climates.

1. *Warm climates*, extending from the equator to 35° lat., that is, 12½° beyond the tropics, comprise nearly all Africa and its islands, South Asia, most of the islands of Polynesia, and the portions of North and South America comprised between California and the north of the La Plata territory. In the equatorial regions the medium temperature for the year is from 80° to 84° F., the min. being 54°, the max. 118°. Near the equator the annual mean temperature decreases slowly as we recede from it, the decrease not amounting to more than 2° F. for the first 10° lat. The difference of temperature during the day is slight, but much greater during the night, owing to radiation. The general variations of the barometer are slight, but the periodical or diurnal variations are very marked. It ascends and descends regularly twice in the twenty-four hours. It ascends from 4.13 a.m. to 9.23 a.m., and descends until 4.8 p.m., ascending again until 10.23. Electrical phenomena are very decided. The rainfall is variable, but 40 inches may be given as a mean. It is generally supposed that heat is greatest at the equator and diminishes as we recede from it; but both observation and astronomical induction lead to the conclusion that not only the maximum of temperature in warm climates is attained at or near the tropics, but also the highest annual mean. The countries in which the highest degree of heat is known to be attained are near the tropic of Cancer, as, for instance, the banks of the Senegal, the Tehama of Arabia, and Mehran in Beloochistan. Moreover, the snow-line, or the line of perpetual snow, is higher at the tropics than at the equator. In the Bolivian Andes, near the tropic, it is 17,000 feet, whereas in the Ecuador Andes, on the equator, it is only 16,000 feet. These facts are partly explained by the unequal progress of the sun after the equinox in its course towards the tropic. In the first month it passes through 12° of latitude, in the second month through 8°. At the end of the second month, therefore, it is 20° from the equator, and there remain only 3½° to be traversed in the third month. The sun receding from the tropic at the same rate at all places between 20° and 23½° of latitude, the solar rays during two months fall at noon either perpendicularly or at an angle which deviates from a right only by 3½° at most.

Another cause which tends to diminish heat in the regions near the equator is the prevalence of rain. For about five degrees north and south of the equator, in the region of the equatorial calms, there are few consecutive days in the year without rain. The principal cause both of the calms and of the rains has been attributed to the meeting in the upper atmospheric regions of the trade winds, north and south. They neutralise each other and precipitate the vapour they hold in solution.

Regions that lie between 5° and 10° of latitude have usually two rainy and two dry seasons. The greater rainy season occurs when the sun in its passage to the nearest tropic passes over the zenith, lasting from three to four months. The lesser rainy season occurs when the sun on its return from the nearest tropic approaches the parallel of the place. The rains then only last from six weeks to two months, and are much less abundant and continual. Countries more than 10° or 12° from the equator have only one rainy and one dry season; the first begins when the sun approaches the nearest tropic, and ends some time after, when in its course from the tropic it has passed the parallel of the place. It lasts from four to six months. Local conditions may modify the course of the dry and wet seasons, as is the case in India, where the dry and rainy seasons depend principally on the monsoons. The amount of rain that falls in a short time within the tropics is very great, much more so than in more northern regions, but these heavy rains do not last continuously as is supposed. Days of continued rain, even in the rainy season, are rarer than in the north. Still, heavy rains are apt to cause great inundations, and to cover large extents of low or level country with water, causing swamps and marshes, very injurious to health.

In the vicinity of the tropics there is a belt, extending over several degrees of latitude, where it seldom rains. This rainless tract is precisely the region which has been already mentioned as that of greatest heat. These belts of rainless regions, extending around the globe on each side of the equator, may be said to separate the countries which lie on each side of the equator from the temperate zones. Thus in Africa the rains cease on the southern border of the desert of Sahara at about 16° N., and begin again at 28° N. On the banks of the Nile the rain ceases about 18° or 19°, to begin again between 28° and 29°. The Tehama, or low coast of Arabia, is all but rainless. This rainless tract crosses Asia as far as China, where there is no rainless region, owing, probably, to the fact, that all parts of China be-

tween 22° and 30° N. lat. are traversed by high mountain chains.

The influence of warm climates impresses certain peculiarities on the peoples who inhabit them. They are the abode of the Ethiopian and Mongolian races of mankind, and appear to have impressed the same characteristics, in a minor degree, on the Caucasian races that inhabit them: a dark complexion and black hair. The inhabitants of these countries are indolent and apathetic. The functions of the skin and liver are peculiarly active, a circumstance which exposes them to severe disease of these organs. The digestive functions are sluggish, and the nervous system is alternately excited and depressed. Remittent and intermittent fevers, dysentery and yellow fever are common. During the dry season disease tends to assume the ataxic, during the rainy season the adynamic form. Pulmonary consumption is frequently met with in the towns, in contradiction to received opinions.

2. *Temperate climates* may be said to occupy the zones of the earth's surface comprised between 35° and 50° or 55° lat. They comprise southern and central Europe, with its islands; the parts of Asia which extend between the Black Sea and the Mediterranean, and Japan; the greater part of North America; a part of Chili and La Plata and Patagonia, in South America. The mean temperature may be stated at from 60° to 50°. The climates in which the mean temperature is from 60° to 68° are often spoken of as temperate, but in reality they approximate closely to warm climates. The four seasons, winter, spring, summer, and autumn, are well marked, but very variable both as to barometrical and thermometrical conditions. The mean temperature in the central regions is, for winter 38°, for spring 51°, for summer 68°, and for autumn 53°. The regions which are near the south and north limits of the temperate zones approximate to the meteorological characters of the warm and cold climates respectively. The periods of the year when storms, rain, and general versatility of meteorological phenomena are principally observed correspond with the vernal and autumnal equinoxes. *The influence* of a temperate climate on the human organisation is salutary, extremes of heat and cold being both trying. Thus the healthiest climates of the world's surface are found in this zone. Intense heat, or even moderate heat if persistent, throws a physiological strain on the liver, skin, and digestive system, and renders mankind prone to severe and fatal diseases of these organs. Intense cold throws a physiological strain on the lungs and kidneys, and exposes them also to severe and fatal disease. The healthiest temperate climates are those in which the winter is not very cold and the summer is not very warm, and in which, consequently, there is no great or continued strain on any one class of organs. The diseases of temperate regions are those that are the best known, as their study and description constitute the foundation of pathological science, ancient and modern.

The climate which, perhaps, the best deserves the appellation of temperate is that of the Mediterranean basin. The winters are not severe on any part of its north shores, and the summers are not intensely hot on its south shores; at least the heat falls short of that of the tropics. There are many conditions of physical geography which conduce to this result. The north shores are protected from north winds by the ranges of high mountains of Southern Europe which skirt them, and the south shores are in close proximity to the hot, rainless tract of Northern Africa—the desert of Sahara, which favourably modifies winter temperature. Moreover, the Mediterranean is a warm sea, but few cold rivers of considerable size flowing into it from the north, a fact which increases the temperature on its shores and islands.

3. *Cold climates* comprise the regions which extend from 50° or 55° lat. to the poles. They may be subdivided into *cold*, with a mean of from 50° to 40°; *very cold*, with a mean of from 40° to 32°; *glacial*, with a mean below the freezing point. In the austral hemisphere the zone contains but little known land, although the existence of an antarctic continent is suspected; in the northern hemisphere it comprises, in Europe, the north of Scotland, Denmark, Sweden, Norway, Iceland, Finland, Lapland, Northern Russia, Spitzbergen, Nova Zembla; Northern Asia, and some of its large plains below 50° lat., Siberia, and Kamtschatka; in America, Canada, including some regions below 50°, the northern lands and islands of Hudson's and Baffin's Bays, and Greenland. In this zone the decrease of the mean temperature is much more rapid as we recede from the equator, than it is in the tropical regions. Thus from the equator to 20° lat. the variation of the mean temperature is not more than 7° or 8°, whereas the variation between 55° and 75° lat. amounts to from 22° to 27°. The coldest region of the globe is not, it would appear, at or near the pole, but at about 80° lat., or 10° from the pole, north of Behring's Straits: the cold of the glacial climates has been exaggerated. At the latitudes of from 70° to 78°, the extreme limit of human habitation, the mean annual temperature is between 19° and 17°, *i.e.* 13° to 15° below the freezing point. The extreme of cold registered, however, reaches a hundred degrees or more below the freezing point. Owing to astronomical conditions there is great disproportion between the length of the nights and of the days at different seasons of the year. In the more northern regions, for several months in the winter the sun never appears above the horizon, and in the summer for several months the sun never disappears below it. Spring, during which the extreme cold is mitigated, lasts but a very short time, and is succeeded by summer, which is in its full strength in June and July. Temperature rises rapidly from 35° to 55° and 60°. In some northern localities it rises to 86° or 90°. Under the influence of the prolonged or persistent days, and of the increased temperature, the vegetation peculiar to each locality passes through all its phases with extreme rapidity. Towards the end of July rain and fog reappear, and are followed by snow and intense cold, the highest expression of which is in January and February. The barometrical changes are the reverse of what obtains in the tropics. Above 60° lat. the diurnal or periodical changes are scarcely perceptible, whereas general or occasional variations become

more marked as we approach the pole. Electrical phenomena become less marked, and above 68° lat. they are scarcely perceptible, with the exception of the aurora borealis. The winds which predominate are the N.E. and S.W., and they change rapidly from one point of the horizon to the other, and thus frequently occasion tempests which extend over considerable areas. The quantity of rain that falls in cold climates is much less than in the tropical and temperate, with some exceptions. Between 60° and 90° lat. it only amounts to a few inches, and falls principally in the form of snow. *The influence* of cold climates is shown on the inhabitants of these countries, who vary much in stature, and possess a vigorous constitution, a sanguineous temperament, great muscular development, active digestive functions, and sluggish nervous powers. Notwithstanding the severity of the climate they generally succeed in protecting life, and live to old age, presenting few diseases peculiar to climatic influences. They are, however, subject to opththalmia and amaurosis, owing to the reflexion of light from the snow in the polar regions, and to scrofula and scurvy, the result of a poor and incomplete dietary. Agues, and intermittent fevers from marsh influences, are rare, and not severe, and disappear entirely as we approach the pole. Continued fevers are met with, but seldom if ever epidemically.

4. *Insular climates* present important peculiarities. The temperature of the sea is more equable than that of the land. Owing to the action of currents, and to the circulation of its waters under the influence of heat, its superficial temperature is warmer in winter and cooler in summer—more equable—than that of the land. It has thus a tendency to warm in winter and to cool in summer the island which it surrounds. Moreover, there is constantly watery vapour arising from the sea which extends to island atmospheres, veils the sky more or less, shields their surface from the ardour of the sun in summer, and prevents great radiation both in summer and in winter. Thus it is that the climate of all islands is more equable than that of continents. This fact is more especially recognisable in the climate of the British Isles, which is also modified—rendered warmer and moister, by the waters of the Gulf Stream impinging on their shores. The warm Gulf Stream, commencing in the tropics, in the Gulf of Mexico, passes northwards along the shores of North America, crosses the Atlantic to the south of Newfoundland, and strikes the shores of the British Islands, of Norway up to Cape North, of Holland, and of France; everywhere raising temperature and the annual mean.

5. *Maritime climates* participate in these influences; temperature is more equable, warmer in winter and cooler in summer, on the shores of seas and oceans than it is inland. Owing to this cause most of the winter sanitaria have been chosen in islands or on the coasts of oceans and seas: such as Hastings, Ventnor, Bournemouth, Torquay, Funchal, Malaga, Cannes, Nice, Mentone, Naples, Salerno, and Algiers.

6. *Continental climates* exhibit conditions the reverse of those which obtain in maritime climates. The tendency is to cold winters and warm summers, owing principally to the absence of the equalizing influence on temperature of large masses of water. A very short distance from the sea is sufficient to establish this difference. Thus the central parts of France are very much warmer in summer and colder in winter than the coasts of Normandy and Brittany. But it is when we reach the centre of continents—Russia, central Asia, central America—that the difference is the most marked.

7. *Mountain climates.*—As we rise above the level of the sea, we meet with two important meteorological conditions. The air becomes more and more rarefied, and the heat diminishes, independently of the more or less obliquity of the sun's rays. The higher we rise above the sea level the more the air is rarefied, and the more the degree of heat due to the solar rays diminishes. We arrive at last, even at the tropics or the equator, at a height, variable according to latitude, where the sun's heat is insufficient to melt the snow. This is termed the snow-line. Mountains attract clouds and watery vapour, and the coolness of their atmosphere causes the precipitation of the vapour in the form of rain or snow. Thus, mountains, mountain-ranges, and the glaciers they contain, are the principal cause and origin of rivers. *The influence* of mountain climates, notwithstanding the clouds, fogs, and rain which characterise them, is proverbially a healthy one, owing to the purity of the air, and, perhaps, to the sparseness of population. They have of late been much recommended for phthisis. The two conditions above mentioned, however, namely, purity of the atmosphere and sparseness of human habitations, are quite sufficient to account for the rarity of phthisis amongst their inhabitants, and for the improvement of the phthisical who resort to them.

Soil modifies climate considerably. Wet and marshy soils are cold, engendering fog and mist. Sandy, dry, well-drained soils are comparatively warm. All sandy plains are warm in summer and cold in winter.

Such are the features which characterise the climates of the terrestrial globe, generally. Each locality, however, each mountain, plain, and valley, each city, village, and house, has a climate of its own, modified by all the meteorological elements which we have successively considered. To discover what each climate is, we must study carefully the meteorological conditions and influences which we have rapidly surveyed in their application to it.

8. *Isothermal climates.*—Owing to the unequal influence of the different elements that constitute climate, the annual mean temperature of regions occupying the same latitude on the earth's surface is very variable. Hence the above name has been given to the regions in which the annual mean is the same. The study of a map on which the isothermal lines are marked is an instructive illustration of the facts above described. Thus it will be seen at a glance that the limit of constantly frozen ground in the central plains of Asia and in the northern plains of America is below 54° F., which is the latitude of York!

The general influence of climate.—The vegetable and animal worlds, including man himself, have been modified in essential characters by

climatic conditions. The study of its influence on their vitality and organisation opens out a wide field to the observer. This study leads to the conclusion that geological periods of time have been necessary to impress on terrestrial life, be it vegetable or animal, the characteristics observed now or formerly in the climates of different regions of the earth. The current of modern research is strongly directed to the elucidation of the influence of climate on life during such geological periods. The investigations of Darwin and his followers may be named as the most remarkable and important illustration of this fact. We may also mention the researches of modern philologists, which have proved, by the study of languages and their roots, that most of the nations of modern Europe have descended from the same Aryan parents as the inhabitants of the Indian peninsula. Climate, in the course of time, has so modified them as apparently to produce different races. For such a change to take place geological lapses of time are certainly required. Our earliest records, dating back several thousand years, show these races such as they are now, quite as distinct. In these days the Aryan races of Europe cannot rear their children in the climate of India, where their Hindoo relatives thrive and propagate their species. In Palestine and Egypt the biblical records, those of the Pharaohs, and those of Nineveh and Babylon, show these regions to have been inhabited, several thousand years ago, by nations and tribes presenting precisely the same race characteristics as those that now inhabit them. During the historical period, the races of Europe have in vain endeavoured to colonise the valley of the Nile; but they have not been able to propagate their species, and have died away, leaving the valley of the Nile to its ancient inhabitants. Their children cannot withstand the heat of summer. On the north-eastern shore of Africa the Algeria of the present, history presents the same record. The Romans and the Visigoths occupied its plains for centuries, continually recruiting their colonies from the mother-countries; and yet, except in the mountains, all traces of their presence has disappeared. They could not rear their children so as to occupy the land of the Arabs. What lengthened periods of time must have elapsed to so profoundly modify races deriving their origin from a common parentage, that they can no longer live and propagate their species in the same climates!

Therapeutical Applications.—The therapeutical application of many of the above facts is contained in the facts themselves. Reasoning suffices to deduce the therapeutical law, and experience proves the correctness of the deduction. A very brief summary only can here be given. *See also* CLIMATE, The Treatment of Disease by.

Firstly, it is clear that if a local climate produces injurious effects on the health of its inhabitants, or of visitors, the latter should leave it, and the regular inhabitants, who cannot leave it, should endeavour by every possible means to modify the pernicious climatic influence to which they are exposed, and to partially escape from its action. This rule may be illustrated by the influence of confined mountain valleys in producing goître, and of marshy districts in producing intermittent fevers. The principle applies to all local climates which exercise a pernicious influence of any kind on the human organisation. When possible the climate should be abandoned; if that is impossible its pernicious influence must be combated by every possible hygienic and therapeutical means.

The injurious effects which extreme climates exercise on the human economy—warm climates on the abdominal and cerebral organs, cold climates on the thoracic—point to change of residence as an important therapeutical agent, the value of which is only beginning to be understood. Our naval and military surgeons have done much to clear up this branch of therapeutics, as regards the diseases of tropical regions. Thus chronic affections of the liver and intestines incurable in a warm climate, often become quite curable if the patient is transferred to a temperate region or to a mountain elevation in the tropics, which reproduces a temperate climate.

Inversely, persons suffering from diseases of the respiratory organs, so common in damp temperate climates like those of France, England, and Holland, find relief by migrating, especially during winter, to warmer regions of the earth's surface, where they escape from the influences which have proved so detrimental to them. Thence the yearly increasing exodus of persons suffering from chronic laryngitis and bronchitis, from bronchial asthma and from phthisis, from the north of Europe to the south.

The increased facilities of locomotion, by rail and by steam, have thus opened out, as it were, a new and important branch of therapeutics, that of the application of climate to the treatment of disease. J. HENRY BENNET.

CLIMATE, The Treatment of Disease by.—Though we can scarcely say with accuracy that change of climate is a specific for disease, yet much can be effected by it in relieving symptoms, and in assisting the reparative powers of the organism by thus improving the general health. The diseases in which change of climate has been found of value will be enumerated below, with a short notice of various climates. Here we may notice the *rationale* of the benefit to be derived from such change.

Change of climate, we must premise, is only a relative term. It does not necessarily involve the idea of removal to a great distance from the patient's home. A few miles' journey from the town to the country, from inland to the seashore, from the plain to the mountain, often suffices to produce marked results. One use of climate being to expose the organism to the effects of *contrast*, the element of distance comes in most when we wish to make the contrast greater; for instance, in ordering change from a cold to a warm climate or *vice versâ*.

The therapeutic elements of most importance in any climate are (1) pure air free from dust and organic particles; (2) abundance of sunshine, without excessive heat, so that much time can be spent in the open air; (3) a temperature without extremes, so that the body is not exposed to the risk of great variations of heat and cold—equability; (4) absence of violent, very

cold, or very hot winds, at any rate of long duration (in this is involved the element of local shelter).

These four elements should be present in each of the subdivisions of climate which a therapeutic classification renders necessary, namely climate of (*a*) the seashore; (*b*) mountains; (*c*) inland wooded districts; (*d*) the open sea.

The epithets 'moist' and 'dry,' which are applied to climates, are merely relative, and depend on local peculiarities of rainfall, soil, &c., as well as to some extent on season; and the essential differences between the climate of the seashore, the woodland, and the mountain remain everywhere the same. We shall say a few words about each of these, with the indications for their use. The climate of the open sea will be referred to in speaking of sea voyages.

(*a*) *Climate of the Seashore.* — The special peculiarities of this variety of climate are that—the air is saturated with moisture, except when dry land winds prevail; it is dense, and, as a rule, therefore, bulk for bulk, contains more oxygen than air of any higher level; its density is liable to great and frequent but regular variations, which increase the activity of the circulatory and respiratory organs, and thus favour their functional activity; it is more equable; and, lastly, it contains saline particles in suspension.

According to Beneke, sea air cools the body relatively quicker than mountain air, and thus quickens the processes of tissue-change the most. Hence the seaside should be ordered where we wish for a highly stimulating effect, as in persons of scrofulous tendency, in chronic diseases succeeding acute ones, or in the later stages of convalescence from the latter, in convalescence from surgical operations, or in some surgical diseases where we wish to accelerate tissue-change, without exertion on the patient's part. On account of the equability of the climate, some patients who cannot bear great changes of temperature do well at the seaside. Persons suffering from overstrain, mental or bodily, with a fair digestive power, and not liable to nervous irritability, may also be sent there.

(*b*) *Mountain Climates* are distinguished from sea-side climates by the lower density of their atmosphere; their lower and less equable temperature; by less humidity, though, owing to local winds, mist and cloud often form; and by relatively lower night-temperatures in clear weather, owing to the dryness of the air, and consequent great radiation. They are cooler also than the inland climates of level districts, and this coolness tends to some extent to diminish the rarefaction and increase the density of their air.

The general action of mountain air is to produce a freer circulation of the blood and greater vascularity of the lungs, owing to deeper and more frequent inspirations and greater ease of bodily movement. Owing to the cooling of the body by the lowered temperature more food is required, the appetite improves, and the body becomes better nourished and gains weight.

The intensity of the effect is, roughly speaking, directly as the height. The term 'mountain climate' is applied in medical parlance to elevations in Europe of from 1,500 to 6,000 feet, though in South America patients have been sent as high as 10 000 feet. or higher.

Mountain Climates are indicated (1) in cases of hereditary tendency to phthisis in young persons with narrow, shallow chests, and who are growing too fast; also in young scrofulous patients. (2) In chronic phthisis and pneumonia; remembering, however, that phthisis occurs at all elevations. The coolness of the mountain air in the height of summer is an important element in phthisical cases, which always suffer from great heat. (3) As a tonic and restorative in persons suffering from over-work in business or literary pursuits, and who have no real organic disease. (4) Generally to complete the convalescence from acute diseases of individuals not past middle life, with a fair amount of muscular power and bodily activity. (5) As a prophylactic against hay-fever, cholera, and other infectious diseases. Mountain climates are not advisable in cases of chronic bronchitis, heart-disease, emphysema, Bright's disease, chronic rheumatism, or for aged persons.

(*c*) *The Climate of Wooded Districts* (elevations above 1,500 feet are not here referred to) is peculiar in the following points:—(1) It has a temperature lower than that of the surrounding country—on the average 3° Fahr.—during the hours of daylight; the temperature is also more equable. (2) The relative humidity is higher (9·3 per cent) in summer than in the less wooded country, and hence there is greater liability to rain and mist. (3) It affords greater protection and shelter against winds than other climates.

The general effect of woodland climates, as may be deduced from the above, is sedative and tonic. They may be advised in chronic bronchitis, emphysema, heart-disease, and in hypochondriasis, hysteria, and other nervous affections where tranquillity and subdued light are of importance; also in the earlier stages of convalescence from acute disease when sea or mountain air is too stimulating. In bronchitis pine woods should be selected, and in heart-disease level walks are essential.

(*d*) *Ocean Climates.—Sea Voyages* have of late years been much recommended in the treatment of phthisis in its early stages, with a view to enable the invalid to spend much time in an exceedingly pure and fairly equable atmosphere, and to secure a sufficient amount of bodily movement without great fatigue.

The main drawbacks to the sea are the impossibility of escape from bad weather and the confinement to close, ill-ventilated cabins, if such occurs; the absence of sufficient light and air below decks, the latter being felt very much at night; want of variety in the diet after a certain time, and at all times (except in short cruises, or coasting trips) of fresh food, milk, &c.; monotony in society and occupations; and, lastly, the inconveniences arising from crowding of the maindeck with hen-coops, sheep-pens, &c., and in steamers from the smoke of the engines, and the smell and vibration of the machinery.

The routes generally recommended to invalids are either to (1) Australia, 90 days; (2) the Cape of Good Hope, 30 days; (3) the West Indies, 14 days; (4) the United States or Canada (in summer), 10 days. Short cruises in the Mediterranean, or to the latitudes of the Canaries and Azores are suitable for certain

cases where expense is no object. Of routes (3) and (4) we may say that they are too short for the full benefit of the sea to be obtained, as improvement does not generally begin for a week or two after sea-sickness has subsided and the patient can remain comfortably on deck. Route (2) does not allow him to get the bracing effect of high South latitudes. Hence where a long sea voyage is indicated, route (1) is decidedly the best. England is quitted in the beginning of October, Australia (Sydney or Melbourne), or New Zealand (Wellington), is reached early in January, and the return voyage is begun not later than the end of February.

Patients should not remain in the coast-towns of Australia in summer on account of the heat. They should go to the table-land of New South Wales, or to Darling Downs in Queensland, or else they should cruise from port to port, or run over to New Zealand or Tasmania.

In returning, the route round Cape Horn should be *avoided* on account of the great risk of the climate of the South Pacific Ocean and the chance of encountering icebergs, fogs, and unfavourable winds. Either the patient should come back round the Cape of Good Hope; or if his strength permits he may cross to California, travel overland to New York and thence by steamer; or, lastly, he may come by the Red Sea, Suez Canal, and Mediterranean.

The invalid must expect about 20 wet days on the voyage out. The temperatures met with range from 40° to 80° Fahr., the coldest and most uncertain weather occurring in the North Atlantic and South Pacific Oceans.

Choice of Vessel.—The following considerations may be useful in deciding between steam and sailing vessels:—

For a steamer there is the greater certainty in predicting the length of the voyage, and the calms of the tropics are sooner passed.

Against steamers, there is the nuisance of steam and smoke on deck; much space is taken up by the engines, stokers' rooms, &c., and hence other parts of the ship are more crowded; the bilge water is tainted with the engine grease; there is the wearying grind of the screw by day and by night; while more seas are shipped, because a steamer can run against a head-wind.

For sailing vessels there are the advantages of more room, light, and air in the cabins, and the absence of the above-mentioned disagreeable conditions.

Against them there is the longer and more uncertain duration of the voyage, and the necessity of shaping their course by the prevailing winds.

A word must be added as to the comparative merits of wooden and iron vessels. Briefly stated, iron ships are cleaner, drier, freer from smell of bilge water, and hence healthier than wooden; but on the other hand they are less equable in temperature (hotter in hot and colder in cold latitudes), and less aërated by natural ventilation through their sides than the latter. They are also noisier.

The vessel chosen should not be under 1,000 tons, and her age, class of passengers, the character, temper, and standing of her captain, as well as the size of her cabins, should be carefully ascertained. Of course it is a *sine quâ non* that she should carry a duly qualified surgeon.

The cabin for the outward voyage to Australia should be on the port side, so as to get the breeze in hot weather, and *vice versâ* in returning.

The cabin outfit should include a spring mattress, with hair (not wool) mattress over, a folding easy chair, chest of drawers, carpet, curtains, and sponge bath (Faber). Clothes of various degrees of thickness are essential, both for body and head, and a waterproof suit is necessary for bad weather.

Plenty of linen must be taken, as washing is difficult on board, and there should be a supply of preserved milk, meat or essence of meat, fruit, and light wines.

The *indications* for a sea voyage are hereditary tendency to phthisis, or the presence of actual but uncomplicated disease in a very early stage, in persons not past middle life, with a fair digestion, absence of severe pyrexia, and general health not much impaired. Patients with a tendency to hæmoptysis should not be sent, nor should those of a desponding disposition, who would thus be likely to suffer by the long absence from home, or from fears of their personal safety. Of course a tendency to protracted sea-sickness is a distinct contra-indication.

The invalid should be careful not to overtax his digestion too much; he should take regular daily exercise on deck to the extent of his strength, have some definite occupation to beguile the time, and, if possible, be accompanied by a personal friend (Faber).

Choice of a Climate—General Hints.—It is a good plan, if possible, to order a patient a climate with that mean temperature and relative humidity which he is known to tolerate well (Sigmund). The patient's disposition must be considered, and a lively or a quiet place chosen according to his temperament. We should not send a poor man to a place beyond his means, otherwise he has to grudge himself many comforts, and loses much, if not all, the benefit of the change. In sending patients to the South of Europe this rule is too often neglected.

The special indications for the climates of particular places can only be understood by studying their local aspect. Generally speaking, as far as Great Britain is concerned, the climate of the east coast is colder and drier than that of the west and south coasts. In Europe the north and west coasts are moister and cooler than the shores of the Mediterranean. As to season, mountain and woodland climates are almost exclusively indicated in summer from May to September. Certain parts of the sea-coast are adapted for invalids at all seasons of the year; but as a rule the northern coasts of Europe and the eastern or south-eastern coasts of Great Britain are best suited for summer, and the south, west, and south-western for winter residence. The Mediterranean coast is only to be recommended from mid-October to the middle or end of May, and Egypt should be quitted not later than April. A word may be added as to the advantages of wintering in the South of Europe. It is incontestable that the invalid gets a milder winter, a longer autumn,

and an earlier spring. Although there is no place where some days of bad weather do not occur, or where uninterrupted calms are met with, yet the number of rainy days is fewer, there is more sun, little or no fog, and, except in the neighbourhood of the Pyrenees, little or no snow or ice. The scenery is picturesque and attractive, and the invalid is able to spend much time in the open air, and to sit out of doors on many days, even in mid-winter. The drawbacks to the South are the risk of chills, owing to the difference between sun and shade temperatures, especially at first, when persons are unaccustomed to the climate, and fail to take sufficient care; the occasional occurrence of high winds, especially in spring; the more limited accommodation, owing to the expense of rooms and living; and the absence of many so-called 'home comforts.'

Those who visit the South must remember that the curative value of the climate consists in its *allowing much time to be spent in the open air*, and in its milder temperature and drier air, which protect the respiratory organs from fresh inflammatory attacks. A south room and warm clothing of the texture usually worn in England in autumn are essential, and a coat or wrap should always be carried out of doors in mid-winter to put on in passing from sun to shade. The invalid should strictly avoid the hot atmosphere of gaslit *salons* at night.

Patients with acute diseases of the respiratory organs should not be sent to the South; and high fever, excessive weakness, or the necessity of remaining in bed, are also contra-indications, owing to the fatigue and risks of the journey and the need of home comforts. Cases of mental disease with excitement, where rest and protection of the mind and body is of primary importance, should not be sent.

In the convalescence from acute diseases occurring in autumn, where a cold northern winter would prevent open-air exercise, and probably set up fresh exacerbations, southern winter climates are of great value.

In ordering change of climate the accommodation, food and water supply, soil and drainage of the locality chosen should be carefully considered, especially if the distance is a long one. The best climate may be unavailable for the invalid, owing to defects in one or more of these particulars.

Lastly, the patient's own feelings should be carefully consulted before he is sent far away from home. In some cases all the benefits of climate are counteracted by 'home-sickness.' *Cælum non animum mutant qui trans mare currunt.*

Enumeration of Climates.—We shall now enumerate various climates and regions suitable for the treatment of cases that can be benefited.

1. Of the Nervous System.—In neuralgia, Arcachon (for the calm, sedative, yet tonic atmosphere of the pinewoods), Cannes (the districts away from the sea), Upper Egypt (Cairo, Luxor, Helwan), Hastings, Hyères, the Engadine, the Bernese Oberland, Pau, Pisa, Rome, the Salzkammergut (Ischl, Berchtesgaden). Some of the above climates will also be found suitable to cases of hemicrania and sciatica.

In hysteria, hypochondriasis, spinal irritation, and in some cases of protracted chorea, Brighton, Cannes, Ischl, Malta, Mentone, Montpellier, Morocco (Tangiers), Nice, Naples, the Bernese Oberland (Grindelwald, Mürren), Palermo, Pau, Seville, Spezia, and Valencia; the effect produced being chiefly due to diversion of the attention by the change of scene, although the bracing influence exerted on the system at large must be taken into account.

In chronic softening of the brain and spinal cord, in paralysis of cerebral origin, and in some cases of locomotor ataxy the South of France may be advantageously ordered in winter, and Alpine climates of moderate height in summer. As a rule hot climates, or those where the sun has considerable power, are contra-indicated where there is a tendency to apoplexy or hyperæmia of the brain.

Temperate and bracing climates are, as a rule, to be recommended in nervous diseases, to restore the general tone of the system.

The immediate neighbourhood of the sea not unfrequently causes nervous excitement, neuralgia, and sleeplessness.

2. Of the Respiratory and Circulatory Systems.—In chronic bronchitis, emphysema, bronchial and spasmodic asthma, as well as in chronic pharyngeal and laryngeal catarrh and laryngeal ulceration the following climates may be recommended:—Algiers, Australia, the Azores, Bordighera, Bournemouth, the Canaries, the Cape of Good Hope (?), Upper Egypt, Glengarriff, Hastings, Hyères, Lisbon, Madeira, Malaga, Malta (?), Mentone, Naples (?), Nervi, Nice, Palermo, Pau, Pisa, Queenstown, Rome, San Remo, Torquay, and Ventnor.

Change of climate is of great value in convalescence from the acute, and as a prophylactic and curative measure in the chronic forms of bronchitis; but we must remember that where there is copious expectoration a dry climate is indicated, while in the irritative forms with scanty sputa (*bronchitis sicca*) a moderately moist mild climate is generally suitable. In emphysema we should choose a mild and not too dry climate, if possible in the neighbourhood of pine-woods, such as Arcachon, on the west coast of France. In spasmodic asthma the choice of climate must be partly a matter of personal experience.

In the early active, and in the quiescent forms of the later stages of phthisis, as well as in chronic pleurisy, and in convalescence from pneumonia, the following (chiefly winter) health resorts and climates have been favourably spoken of:—Algiers (?), Australia, Bordighera, Bournemouth, Cannes, Davos, Upper Egypt, Upper Engadine (in summer), South of France, Hastings, Hyères, Queenstown, Ischl (in summer), Madeira, Malaga, Mentone, Natal (?), Nervi, Nice (?), the Oberland (in summer), Palermo, Pau, Pisa, San Remo, Sicily, Spezia, Torquay, Glengarriff, and the Undercliff (Isle of Wight).

In chronic endocarditis, pericarditis, and in heart-disease generally, a rather bracing climate, without extremes and of the character suited to chronic bronchitis, is usually indicated. Here both the tonic effects of climatic change and the prevention of pulmonary complications and fresh rheumatic attacks must be taken into account.

Mountain resorts of *moderate* height, well protected from sudden changes of temperature, may be prescribed in summer (von Dusch).

In the neuroses of the heart, including (1) angina pectoris, (2) palpitation associated with chlorosis, hysteria or hypochondriasis, and (3) exophthalmic goître, bracing climates are indicated. In angina pectoris long journeys involving great exertion must be rigorously forbidden, as must also sightseeing or exciting amusements.

3. **Of the Abdominal Organs.**—In the various forms of chronic dyspepsia and intestinal catarrh, in chronic hepatic disease, in chronic dysentery (after removal from a malarial district or tropical climate), in diabetes, and in chronic endometritis, pelvic cellulitis, and other diseases of the uterus and its surroundings, the following climates may be selected from:—Cannes, The Engadine, Hastings, Hyères, Lisbon, Malta, Mentone, Montpellier, Morocco, Naples, Nice, the Nile, the Bernese Oberland, Pontresina, the Pyrenees (in summer), Queenstown, the Salzkammergut, Seville, Spezia, St. Moritz, Valencia, and Ventnor.

In convalescence from acute nephritis, and in all forms of chronic Bright's-disease, but especially *catarrhal* nephritis, warm dry climates are indicated. Among the best are Upper Egypt, the Riviera, the Cape of Good Hope (inland), Bombay; and in England: Brighton, Folkestone, and Ventnor.

In renal calculus removal from particular districts in which stone is known to be prevalent may possibly be of use in some cases.

4. **Of the System at large.**—Change of climate is here nearly always indicated:—

(1) In convalescence from typhus and typhoid fevers, scarlet fever (at the end of the desquamative stage), measles, diphtheria, and acute rheumatism; also in the third stage of protracted hooping cough.

(2) As a prophylactic against all infectious diseases, and especially cholera, yellow fever, hay fever, influenza, and malaria; also against rheumatism and phthisis by withdrawal from damp districts, and goître and cretinism by removal from the *ensemble* of conditions to which the latter are due.

(3) In rickets, scrofula, chlorosis, general anæmia, and functional debility. Here, where a pure air and a bracing sunny atmosphere are the chief indications, the climates enumerated in section 1, page 268, are suitable, as are also Algiers, Biarritz (in autumn), the Cape of Good Hope, Ischl, Malaga, Rome, Sicily, St. Moritz; and in Great Britain a number of inland and seaside places (Malvern, Scarborough, &c.) which we have not space to mention.

EDWARD I. SPARKS.

CLINICAL (κλίνη, a bed).—This word literally signifies 'of or belonging to a bed'; but it has been particularly applied to the practical study and teaching of disease at the bedside; and has more recently been extended to all that relates to the practical study of disease in the living subject generally.

CLONIC (κλόνος, commotion).—This word is applied to spasmodic movements which are of short duration, and alternate with periods of relaxation. *See* CONVULSIONS, and SPASM.

CLONUS. *See* SPINAL CORD, Diseases of; p. 1458.

CLOT.—A clot, or coagulum, is the product of the formation of fibrin. The separation or formation of fibrin is attributed to the union, under the influence of a ferment, of the fibrinogenetic substance or fibrinogen which is contained in the liquor sanguinis, the juice of the flesh and most of the serous fluids, with the fibrinoplastic substance which is contained in the blood-globules, the lymph-corpuscles, and the cells of the body generally. Coagulation of the blood within the blood-vessels is described under THROMBOSIS; the coagulation of extravasated blood under HÆMORRHAGE and BRAIN, Hæmorrhage into; and the coagulation of inflammatory exudations under INFLAMMATION and EXUDATION. *See* also BLOOD, Morbid Conditions of.

CLOTHING. *See* Disease, Causes of; and HEALTH, Personal.

COAGULUM (*coagulo*, I curdle). *See* CLOT.

COAL GAS, Poisoning by.—Coal gas, so largely employed for illuminating purposes, is a compound, containing—in addition to olefiant gas and analogous hydrocarbons, on which the luminosity principally depends—certain so-called diluents which burn with a non-luminous flame, viz., hydrogen, marsh gas, and carbonic oxide along with what are termed impurities, of which the chief are carbonic acid, sulphuretted hydrogen, and bisulphide of carbon. On these impurities the characteristic odour mainly depends. This odour, which is perceptible even to the extent of 1 in 10,000, is a valuable safeguard against accidents from escape of gas.

A mixture of coal gas with the air inhaled exerts a deleterious effect on the system, and proves fatal when it reaches a certain percentage. In addition to the danger from inhalation, fatal accidents frequently occur from the explosive nature of the compound which is formed when the gas reaches the proportion of 1 to 10 of the atmosphere. Much less than this, however (a non-explosive mixture, therefore), proves fatal if long inhaled.

It is difficult to determine the exact proportion of the gas present in atmospheres in which fatal accidents have occurred, but we derive important information on this point from experiments on animals. Many such have been made. M. Tourdes, who has carefully investigated the subject, finds that pure gas is almost instantaneously fatal; $\frac{1}{8}$th kills rabbits in five minutes, and dogs in twelve minutes; $\frac{1}{15}$th kills rabbits in from ten to fifteen minutes; $\frac{1}{30}$th still proves fatal after a longer period; and evident signs of distress are caused in rabbits by an atmosphere containing only $\frac{1}{50}$th of the gas. Dr. Taylor (*Edin. Med. Jour.*, July, 1874) has estimated the proportion of gas existing in a room in which a fatal case occurred at three per cent.

SOURCES OF POISONING.—Poisoning by coal gas is only known of as an accident. Occasionally suddenly fatal consequences ensue among workmen from exposure to a sudden rush of undiluted gas from gasometers and mains. More commonly slowly fatal cases result from the gas

tap in a bed-room being left open carelessly, from accidental extinction of the light, or from leakage of gas-pipes in a house or at a distance; the gas gaining access to the house in the latter case through cellars, walls, and more especially by means of drains and sewer-pipes.

Symptoms.—Gas, even when in comparatively small proportion and just sufficient to cause an unpleasant odour, acts deleteriously if long breathed, and gives rise to headache and general depression of health.

In severe and fatal cases the symptoms which have been noted are headache; nausea or vomiting; vertigo; and loss of consciousness, passing into deep coma and muscular prostration, which resembles the apoplectic state, the individual lying insensible and incapable of being roused, with livid features, stertorous breathing, and froth at the mouth. Death usually occurs quietly, in this state of coma, but occasionally with convulsions.

The state of the pupils does not seem to be constant, though they are generally dilated before death.

In Dr. Taylor's case the teeth were firmly clenched, and the eyes were in a constant state of lateral oscillation.

Fatal Period.—The fatal period of poisoning by coal gas is extremely variable, and a remittent character of the symptoms sometimes gives rise to fallacious hopes of recovery in cases which ultimately prove fatal.

Diagnosis.—The smell of gas in the clothes, breath, and perspiration, which continues for a considerable time after removal from the infected atmosphere, is the best indication of the cause of the coma.

Anatomical Characters.—The smell of gas is often very marked. M. Tourdes has found, as the most constant appearances, a dark colour of the blood, which, however, coagulates; a bright colouration of the pulmonary tissue; froth in the air-passages; congestion of the mucous membrane at the base of the tongue more particularly; engorgement of the cerebral and spinal venous system; and rose-coloured patches on the thighs.

Mode of Action.—It is obviously impossible to differentiate between the effects of the various constituents of coal-gas, but we have good reason for believing that the most active agent is the carbonic oxide, which exists in the proportion of from five per cent. (English gas) to twenty-five per cent.

The symptoms in the main agree with those caused by carbonic oxide (*see* Carbonic Oxide, Poisoning by), and the effects, therefore, would be chiefly due to the action of the carbonic oxide on hæmoglobin.

Treatment.—Instant removal from the infected atmosphere is the first thing to be attended to. Attempts must then be made to cause oxygenation of the blood by artificial respiration and excitation of the respiratory centres by reflex stimulation of the face, chest, &c.

Pure oxygen gas may be administered. As, however, the compound which carbonic oxide makes with the blood-colouring matter is a very stable one, and not easily broken up by the introduction of atmospheric air or oxygen, it not unfrequently happens that these measures prove of no avail. In such cases it would be highly advisable to perform venesection, and then transfuse fresh blood, a plan of treatment which has been found successful in poisoning by carbonic oxide. D. Ferrier.

COARCTATION (*coarcto*, I straiten).—A pressing together, narrowing, or stricture of any hollow tube, such as the aorta, intestine, or urethra.

COLD, A.—A popular name for Catarrh. *See* Catarrh.

COLD, Ætiology of. *See* Disease, Causes of.

COLD, Effects of Severe or Extreme.—The general effect of exposure to severe or extreme cold is to lower, even to extinction, all vital activity. The blood-vessels, especially the smaller arteries and capillaries, after a brief period of congestion, become contracted, the latter to such an extent as no longer to permit the passage of the red corpuscles; the normal condition, composition, and structural integrity of the various tissues are more or less impaired, or altogether destroyed; and those processes of chemical and physiological change which are essential to every manifestation of life, being only possible within certain very narrow limits of temperature, are hindered or absolutely prevented.

Effects and Symptoms.—The more special effects vary in degree and kind:—1stly, with the degree of cold, the duration of the exposure, and the medium or manner of application; 2ndly, with the part, and extent of surface exposed; and, 3rdly, with the general constitution and physiological condition of the sufferer. Moderate cold, acting during a short time, or even severe cold during a still shorter time, followed by the glow of speedy reaction, exercises a tonic and stimulating influence. But if the cold is too severe, or the exposure too long, no glow of reaction occurs, but a sense of depression is experienced, from which, at best, recovery takes place but slowly. Continued exposure to such degree of cold as is yet not incompatible with the maintenance of life, nevertheless keeps at low ebb activity of nutrition and function alike. Extreme cold and long exposure lead to congelation and consolidation of the various tissues of the body. After complete congelation recovery is impossible. Dry cold is much less readily injurious in its influence than cold associated with wet. The better conductor of heat the medium is, the more speedily and completely does it reduce the temperature of the part with which it is in contact. Immersion in water cools more rapidly than exposure to air of the same temperature; and contact with wool, wood, or metal, of the same degree of coldness, excites in each case a different sensation, and leads to a different result, or to the same result with very different rapidity. Constant renewal of the medium in contact hastens the cooling effect; and a continuous draught of only moderately cold air may do more to chill than temporary exposure to an intensely cold, but still atmosphere. If some external part, and a comparatively small extent of surface only, be acted upon, the effect may be simply local, and

the general disturbance of the system scarcely appreciable. But if the whole body, or a considerable extent of surface, or any important internal organs be acted upon, a proportionately serious general effect is produced. The young (infants especially) and the aged alike ill sustain exposure to cold, and are most liable to suffer, not only from its direct effects, but also from the various maladies to which it gives rise. The feeble, ill-nourished, and broken in health, especially the subjects of organic disease, or of degeneration due to habitual intemperance, readily succumb, or only slowly and imperfectly recover. Among the healthy and otherwise vigorous, hunger, fatigue, sleep, anxiety of mind, fear and mental depression of whatever kind, lower—too often even to fatal issue—the power of resistance to the deadly influence of cold.

For *local effects* of exposure to cold *see* Chilblain, Frost-bite, and Gangrene.

The *General Effects* produced by exposure to severe or extreme cold vary somewhat in different cases. Temporary exposure produces, first, a sense of coldness or chilliness, associated with paleness and corrugation of the skin (the so-called *cutis anserina*), then shivering and tingling sensations, followed by numbness and diminution of muscular activity and power. Healthy reaction restores more or less quickly the normal condition. Prolonged exposure to extreme cold gives rise to a series of symptoms, graphically described by Beaupré somewhat as follows:—Reaction has a limit, and a moment arrives when the powers are exhausted. Shiverings, puckerings, paleness and coldness of the skin, livid spots, muscular flutterings, are symptoms of the shock given to the vital forces; syncope approaches; the stiff muscles contract irregularly; the body bends and shrinks; the limbs are half-bent; lassitude and languor invite to repose; a feeling of weight and numbness retards the steps; the knees bend; the sufferer sinks down or falls; the propensity to sleep becomes irresistible; everything grows strange; the senses are confused; the mind grows dull, the ideas incoherent, and the speech stammering or raving; respiration, at first interrupted, becomes slow; the heart's action is feeble, quick, hard, irregular, and sometimes painful, and the pulse progressively smaller; the pupils dilate; the brain becomes stupified; and finally deep coma indicates the approach of inevitable death.

Other, and somewhat different effects and symptoms, attributable to differences of circumstances and condition, have been from time to time observed. Distressing and almost intolerable thirst, with loss of appetite for food, is often experienced; and the attempt to obtain relief, by sucking snow or ice, only adds to the suffering. Somnolence is by no means so constant an effect as is commonly supposed—at any rate, in the earlier stages, and less extreme cases. On the other hand, inability to sleep has proved a common cause of suffering and consequent loss of strength. The manifestations of brain-disturbance due to exposure to cold, varying as they do from dullness, incoherence, wandering and thickness of speech to even raving delirium, are especially worthy of note, inasmuch as they resemble, and are liable to be mistaken for, the effects of alcoholic intoxication.

Death from the direct and immediate effects of cold is rare in our country; but it is estimated that in the Russian Empire, on an average, 694 deaths occur annually from this cause. The length of time during which exposure can be sustained varies greatly with the condition of the individual and with surrounding circumstances, as well as with the degree of cold. Under ordinary circumstances, an hour's exposure to intense cold often suffices to determine a fatal result. At the same time, well-authenticated cases are on record, in which persons buried, for days even, in the snow, have nevertheless survived and ultimately recovered with little permanent damage.

Mode of Death.—The immediate cause or mode of death from cold seems in some cases to be principally shock; in some, syncope; in others, asphyxia; and in others, again, coma. In most cases it is probable that these several conditions, with others less readily specified, combine to produce the fatal issue.

Anatomical Characters.—The appearances presented on post-mortem examination are somewhat differently described and estimated by different observers; but none of them are absolutely pathognomonic, and some are as likely to be produced by exposure of the body after death as during the process of extinction of life. Among the more noteworthy are the following:—strong cadaveric rigidity; paleness or waxy whiteness of skin, with patches of more or less bright redness about the face, neck, and limbs, especially on exposed or prominent parts; a contracted and shrunken condition of the male genital organs; comparative bloodlessness of superficial and external parts; accumulation of blood in and about the thoracic and abdominal viscera; great distension of all the cavities of the heart, with more or less clotted and often bright-coloured blood; the blood in other parts also sometimes of brighter colour than usually seen on post-mortem inspection; hyperæmia and congestion of the lungs; hyperæmia of the brain, overfulness of the sinuses, and excess of serous fluid in the ventricles, and at the base, in some cases; in others, comparative bloodlessness of the surface of the brain, and no distension of the sinuses; excessive fullness of the urinary bladder; and, lastly, separation of the cranial bones along the coronal and sagittal sutures. The lines of reddish or brownish staining along the course of the superficial blood-vessels, relied on by some as pathognomonic, are certainly not so, inasmuch as they depend upon exosmosis of the blood colouring-matter set free by disruption of the corpuscles, which may be effected by freezing after death, as well as before.

Treatment.—The treatment of sufferers from the effects of cold, consists in the restoration of warmth, and the rekindling of those processes by which the natural heat of the body is maintained. But this must be done gradually, and with great care. As in the treatment of a frostbitten part, so in the treatment of the body generally—all sudden or rapid elevation of temperature must be avoided. The sufferer, divested of the clothing previously worn, and wrapped in blankets, should be placed in the recumbent position in a room,

the air of which is dry, still, and cold, but capable of being gradually warmed. Gentle, but continuous friction should be made over the trunk and limbs, care being taken that rigid or frozen parts be not damaged by rough manipulation. At first, ice or ice-cold water may be used; afterwards dry rubbing with flannel or with the hands is better · later still some stimulating liniment may be employed. Some recommend immersion of the body in a bath of cold—at first ice-cold—water, the temperature of which can be gradually raised. This method would seem easy and advantageous, if means are at command. When the sufferer can swallow, warm, gently stimulating, drinks—as tea, coffee, aromatic infusions, beef-tea, or soup—may be given, at first without, but later with some wine or spirit. Alcohol, though useless or injurious if taken to fortify against cold, is useful and beneficial when judiciously administered as a restorative after exposure. In all cases of insensibility, and even apparent death from cold, every effort must be made to restore animation; and the attempt must be persevered in for a considerable time before being given up as hopeless. It is often difficult, sometimes impossible, to judge whether life is absolutely extinct or not. And while, on the one hand, it is important that the temperature be not raised too quickly, lest reaction should be too strong or dangerously irregular; on the other hand, it is equally, if not more important, that the needful measures be adopted without delay, and carried out not too slowly, lest the chance of revival should be lost. In the less severe cases, restoration of warmth may be comparatively quickly accomplished. The state of the bladder should always be examined, and relief afforded, if needful, by aid of the catheter. Attention to the general health is often requisite for long after recovery from the more immediate effects of exposure has taken place. Rest, good nourishment, and tonics are indicated.

Cold as a Cause of Disease.—As a predisposing and exciting cause of disease, cold proves, in this country, year by year, more fatal in its effects probably than any other single condition or influence. Any considerable fall in the thermometer below the average standard during the colder months of the year is constantly followed by a corresponding rise in the death-rate, and an increase in still greater proportion in the amount and extent of sickness and suffering. The Reports of the Registrar-General clearly prove this, so far as the death-rate is concerned. A striking instance may be quoted. In the week ending December 19, 1863, in the London district 1,291 deaths were registered. Severe frost set in, and in the week ending January 9, 1864, the number rose to 1,798. The week following, ending January 16, no fewer than 2,427 deaths were registered. This enormous increase could be attributed to no other cause than the effects of the severe cold which prevailed. The Registrar-General also shows that after the age of from twenty to forty the mortality from cold increases in something like a definite ratio with increasing years.

General depression of the vital powers, congestion and functional derangement of various internal organs—the lungs, liver, and kidneys—catarrhal and other forms of inflammation of the mucous membranes, especially of the respiratory tract, but also of the intestinal canal and bladder, paralysis from central or peripheral lesion, together with rheumatism, chilblain, frost-bite, and gangrene, constitute the list of maladies most commonly caused and fostered by exposure to the influence of cold. ARTHUR E. DURHAM.

COLD, Therapeutics of.—The therapeutic uses of cold are various and extensive. Cold may be applied as moist cold, by means of wet compresses and cold lotions or baths; and it may also be used as dry cold in the form of ice enclosed in a receptacle of metal or india-rubber. Each of these methods has its special advantages and adaptations. Furthermore, cold may be made use of by the mouth, and by injection into the mucous canals of the body.

GENERAL PRINCIPLES.—The general effect of cold, however applied, is to lower temperature, to diminish sensibility and fluidity, to contract the tissues and vessels, and so to reduce the volume of parts. The cold bath and cold sponging alike have the effect of lowering the temperature of the body. The fall of temperature sometimes is but transient, reaction setting in and heat of surface returning when the body is withdrawn from the cooling medium. At other times the temperature continues to fall after the individual is removed from the bath. If the action of the cold bath be prolonged, then a thermometer, introduced within the rectum, shows a great depression of temperature, and much pain is experienced, similar to the severe pain which is felt in the hand and arm when the former is held for some time in water at a temperature of 41° Fahr., and which soon compels the withdrawal of the hand from the vessel. Cold baths and their uses are treated of in another article, but attention may here be drawn to the practice of cold sponging over the surface as an efficacious means of lowering preternatural heat and relieving acridity and dryness of the skin during fever. Reduction of hyperpyrexia by means of cold is now a well-established therapeutic method. *See* TEMPERATURE; and Special Diseases.

METHODS OF APPLICATION AND USES.—**1. Cold Affusion and Wet Packing.**—In the practice of cold affusion, introduced by Dr. Currie, in 1797, the patient is unclothed, seated in a tub, and four or five gallons of cold water thrown over him. Thus, Dr. Currie said, a commencing fever might be 'extinguished.' In cases where the skin was burning hot and dry, it was observed that after the cold affusion, temperature fell, perspiration broke out, and the patient usually dropped into a refreshing sleep. If the body-heat did not exceed 98 5° Fahr., or if the patient was damp and chilly, with or without delirium, the cold affusion was regarded as dangerous and by all means to be avoided. In fevers complicated with any visceral inflammation, the cold affusion is prejudicial. Drs. Strauss and Hirtz speak most highly of the marvellous effect of cold affusion in cases of collapse during fever. This kind of collapse appears due to a paralysis of the nervous centres: the heart's action fails, as does also the respiration; but while the surface of the body is cold, the temperature, taken in

the rectum, still remains abnormally high. The affusion is applied by pouring a pitcherful of water, at a temperature of, or a little above 10° C. (50° Fahr.), over the patient seated on a waterproof cloth. The patient, plunged in stupor, is suddenly roused by the shock; he draws a long breath, the respiration becomes fuller; the cardiac ataxy ceases, and the pulse, which, traced by the sphygmograph during the collapse, presented a scarcely broken horizontal line, now regains its normal line of ascension; heat of surface returns, and the temperature in the rectum falls. The action of the cold affusion, as thus applied, is to excite immediate and energetic reflex action.

In many nervous affections, such as chorea and hysteria, cold douches, shower baths, and affusions are valuable as restorative and curative agents. In the convulsions of robust children, a stream of cold water directed over the head from a height of two or three feet often has a speedily beneficial effect. Cold affusion has been tried in tetanus, but it has in some instances killed the patient (Elliotson).

Other cases in which cold affusions are of service are those where respiration fails, and it is necessary to appeal powerfully to the reflex excitability of the nervous centres. To resuscitate those who are in danger of death from a narcotic such as chloroform or opium, slapping the patient severely with a cold wet towel is an efficient method. In sun-stroke cold affusion over the head and neck may be resorted to, provided the skin be not cold and clammy and the patient in a very syncopal state. In conditions of nervous spasm, of the larynx for example, cold douches over the neck may prove useful. Cold affusion to the feet was much commended by Cullen as a means of promoting action of the bowels in cases of obstinate constipation. Spasmodic retention of urine has been relieved by cold douche over perineum and thighs (Currie); and Mr. Erichsen mentions the case of an old man who found his power of micturition increased by sitting on the cold marble top of his commode.

In cases of extreme debility, with damp, cool skin, low muttering delirium, and very feeble pulse, cold affusions are dangerous.

In some cases of fever, where for any cause a cold bath is objectionable, the patient may be wrapped in a wet sheet and then covered with a few blankets. The sheet as it becomes heated may be changed for one fresh and cold, or very cold water may be squeezed from a sponge over the sheet as the patient lies rolled up in it on a waterproof cloth. In scarlet fever of malignant type, where the rash does not readily appear, this form of cooling pack has been found most valuable. Drs. Hillier and Gee have both added their testimony to its utility. In Dr. Gee's cases the patient remained packed in the wet sheet for one hour and was then removed to bed. The cases best suited for treatment by the wet pack are those where the skin is very dry and hot, and the patient exceedingly restless and delirious.

2. Cold Compresses, Irrigations, Lotions, and Injections.—Cold may be continuously applied with a view to abating undue heat of a part of the body. Thus iced-water rags or *compresses* may be placed over an inflamed throat, or on the head in inflammation of the brain. In acute pneumonia Niemeyer has commended strongly the use of cloths dipped in cold water, well wrung, and then applied so as to cover the chest and especially the affected side. These compresses are repeated every five minutes. Pain and dyspnœa are much relieved; sometimes the temperature falls an entire degree; and if the cold appliances do not arrest the actual attack of pneumonia, they shorten its duration and promote speedy convalescence. The necessity of so often having to change the compress, and thus disturb the patient, is a great objection to this mode of applying cold.

A powerful sedative and antiphlogistic effect of cold can be obtained by *irrigation*; i.e. allowing cold water to fall drop by drop on a cloth, so as to keep it continually wet with fresh supplies of water. This may be done by suspending over the part to be irrigated a bottle of water, in which a few pieces of ice may be put; one end of a skein of cotton, well wetted, is then allowed to hang in the water, while the other end is brought over the side of the bottle. This, acting as a syphon, causes a continual dropping upon the part to be irrigated. In injuries of joints, where it is of much consequence to check inflammation, this process, which abstracts heat gradually, and without disturbance of the part, is most valuable. Irrigation of the shaven scalp in cases of meningitis is a very powerful, cooling, and sedative appliance, requiring care and watchfulness. A cap of india-rubber over the head and back of neck, so arranged that a current of cooled water may flow continuously through it, will act as a general reducer of temperature. Where pounded ice is applied to the head in a bladder, this should be suspended by a string from the bedstead, so that the head of the patient may not have to sustain the weight of the bag and its contents. Five ounces of sal ammoniac and five ounces of nitre in a pint of water will form a frigorific mixture, which can be applied in a bladder when ice is not at hand. The ice-bag, and cold water compresses renewed every three minutes, have been used as an appliance to strangulated hernia, and to prolapsed rectum, to reduce the volume of the part and so facilitate reduction. Care must be taken that the cold application be not continued so long as to cause gangrene. Cold wet compresses should not be applied over dry bandages, with which wounded or broken parts are secured. Several cases are recorded where a hand or arm has become gangrenous, in consequence of having been bound up with dry bandages, and then treated with cold water compresses. The dry bandages, as they become wet, contract tightly on the limb, thus stopping circulation and causing gangrene.

A mixture made of spirit of wine and water, or of eau de cologne with water, is a simple form of *cooling lotion*. The spirit evaporates and so carries off heat from the surface. 1 oz. of rectified spirit to 15 of water makes a good spirit lotion, and the addition of 4 drachms of nitrate of potash, or chloride of ammonium, will add to its cooling and sedative effect. 4 drachms of the chloride of ammonium with half an ounce of diluted acetic acid, and the same

quantity of rectified spirit in 15 ozs. of camphor water, is another form for a very serviceable lotion. These lotions, applied by means of a piece of soft rag or lint over the skin, act as refrigerants, cooling the head when it is hot or painful; reducing heat and arterial excitement in tumours or contusions; and tending in the latter to promote the absorption of effused blood. Cold water, and cold lotions of vinegar and water, are familiar means for trying to stop hæmorrhage.

In cases of severe uterine hæmorrhage, *injections* of ice-cold water into the vagina, or into the rectum, frequently succeed in checking the bleeding. In cases of bleeding internal piles an injection of cold water, after the action of the bowels, braces the parts and constringes the bleeding vessels.

3. **Dry Cold. Uses of Ice.**—Heat may be continuously abstracted from an inflamed part in a safe way, and without undue risk, by applying dry cold by means of a waterproof bag of vulcanised india-rubber filled with ice, snow, or a freezing mixture made of equal parts of salt, nitrate of potash, and chloride of ammonium. Moisture from the air will condense on the exterior of the cold bag, but a piece of lint interposed will protect the skin from damp. The india-rubber is a bad conductor, and too great abstraction of heat need not be feared. The walls of an animal bladder conduct heat much better than the india-rubber, and it is necessary to watch carefully over the application of ice-bladders, for when continuously applied they have been known to cause severe frost-bite of the part. If, when cold is being applied, the patient persists in complaining of severe pain, it is right carefully to examine and see how the part is affected by the cold. Professor Esmarch, in cases of fracture, and in various forms of traumatic inflammation, has applied ice for periods of twenty or thirty days with the best results. In cases of commencing disease of the vertebræ this surgeon has used cold water placed in a tin vessel, so made as to adapt itself to the part to be treated. Minor cases of bruise with inflammation may be treated by cold employed in the form of a common bottle filled with cold water and kept pressed against the part. After operations upon the eye, the extraction of cataract for example, a small ice-bag is very useful in relieving pain and keeping down inflammation.

Ice-bags placed along the course of the spine have been found effectual remedies in many forms of nervous disorder. In cases of epilepsy, where the circulation is sluggish, the hands and feet being always clammy and cold, an india-rubber bag of ice applied along the spine has been found to restore warmth, at the same time relieving headache and symptoms of incipient paralysis. Cold to the spine is asserted by Dr. Chapman to lessen the excito-motor power of the cord. In the severe pain of an inflamed ovary or testicle ice in a bag may often be employed beneficially as an anodyne.

Lumps of ice swallowed are invaluable in arresting hæmorrhage from the throat and stomach. In tonsillitis and diphtheria this same treatment tends to reduce inflammation and cool the throat of the patient. Obstinate vomiting can often be checked by swallowing fragments of ice.

4. **Cold as an Anæsthetic.**—Dr. James Arnott, in 1849, brought forward the use of a freezing mixture of ice and salt as a means of producing local anæsthesia, by freezing the part to which the mixture was applied, either in a bag or in a metallic spoon. For small superficial operations this method of anæsthesia by congelation answers very well. The part becomes white and hardened to the cut of the surgeon's knife, there is very little hæmorrhage, and the wound made usually heals well by primary adhesion.

More recently, Dr. Richardson has indicated a very convenient way of inducing local anæsthesia, by the volatilization of ether in the form of spray, by means of the hand-ball spray atomizer. Ether sprayed on the bulb of a thermometer, held about an inch from the jet, brought down the mercury to within 10° Fahr. of zero. When the jet was turned on to the skin, a marked degree of local anæsthesia was produced, but not enough for surgical purposes. By driving over the ether under atmospheric pressure, instead of trusting simply to capillary action—or to suction, as in Siegle's apparatus—one may bring the thermometer within thirty seconds to 4° below zero. By the use of this apparatus, at any season or temperature, the surgeon can produce cold even 6° below zero; and by directing the spray upon a half-inch test-tube containing water, he can produce a column of ice in two minutes. For local anæsthesia by cold, the ether spray answers well. Such operations as the removal of small tumours, opening abscesses, and inserting sutures, may be painlessly performed. JOHN C. THOROWGOOD.

COLIC (κῶλον, the large intestine).—Originally colic signified a painful affection due to spasm of the bowel, but though still retaining this application, it has now come to be further associated with other complaints which are attended with severe pain of a spasmodic character, a qualifying adjective indicating the nature and seat of each particular form. Thus *renal colic* is applied to the group of symptoms due to the passage of a stone from the kidney to the bladder; *hepatic colic* to those accompanying the escape of a gall-stone. *See* COLIC, Intestinal.

COLIC, INTESTINAL.—SYNON.: Fr. *Colique*; Ger. *Die Kolik.*

DEFINITION.—Painful and irregular contraction of the muscular fibres of the intestines, without fever.

ÆTIOLOGY.—*Predisposing causes.*—These include the nervous (as hysteria, hypochondriasis), lymphatic, and bilious temperaments; sedentary occupations; the female sex; and the period of youth or adult age. *Exciting causes.*—These may be grouped as follows:—1. Irritation from lodgment of gas due to fermentation of undigested food and decomposition of fæces long retained within the large intestine; from fæces, or intestinal concretions, undigested or partly digested food, such as pork, shell-fish, salt meats, unripe fruit or septic game; from cold drinks or ices; from excessive or morbid secretions, especially bile; from gall-stones; or from worms—a bundle of

round worms or coiled up tape-worms. 2. Morbid states of the bowel, including obstruction from intussusception, twisting, strangulation, &c.; ulceration (typhoid, tubercular, dysenteric); inflammation (enteritis, typhlitis, &c.) 3. Reflex nervous disturbance, due to anxiety, fright, anger, or other emotional disorder; to disease of the ovaries or uterus; to calculus (hepatic or renal); to dentition; or to exposure, especially of the feet and abdomen, to cold. 4. Blood-poisoning, as from lead, copper, gout, rheumatism.

Symptoms.—The characteristic or essential symptom of intestinal colic is pain in the abdomen, without febrile disturbance. It usually begins, and is most severe, in the umbilical region, then spreads to other parts, or to the whole abdomen, and is apt to travel from one part to another. It is almost always relieved by firm pressure and by expulsion of flatus, and is paroxysmal in character, remitting, or exacerbating, or completely subsiding at intervals. The suffering is usually severe, often agonising, and to relieve it the patient bends forwards, pressing the abdomen firmly with his hands or against some hard surface, or rolls about. As a rule the abdomen is distended by flatus; in lead-colic it is, however, firmly retracted towards the spine, and the movements of the inflated intestines affected by spasmodic contraction, producing loud borborygmi, may frequently be seen and may be felt by the hand applied to the abdomen. The muscles of the abdominal wall and the bladder usually participate in the internal spasm: the abdomen becomes rigid or knotted, and the recti muscles become contracted into round balls, while frequently the navel is retracted; micturition is frequent or suppressed. Usually there is constipation, and the pain disappears when the bowels are freely relieved; sometimes, however, it persists for a time. Constipation stands in a twofold relation to colic, either as cause or effect of the spasm.

The countenance expresses great suffering, anxiety, and depression, and the features may be pinched. The surface of the body is cold, especially the feet, and the pale skin is covered by a cold perspiration. The pulse is commonly of normal frequency, or is infrequent and feeble.

The symptoms vary somewhat with the cause. When due to irritating ingesta the prominent symptoms are vomiting and diarrhœa, sometimes ending in catarrhal dysentery. In children the legs are drawn up upon the abdomen, the bowels are often at first confined, and the evacuations greenish, offensive, and very acid, afterwards becoming loose.

In nervous and hypochondriacal subjects, and especially females, severe pain in the intestines, resembling that of spasmodic colic, is apt to occur (*see* Enteralgia). Flatulence plays a varying part in different cases; it is often a prominent symptom, and the form of colic thus characterised has been termed Colica flatulenta.

Vomiting is generally in proportion to the severeness of spasm, and the degree of intestinal obstruction.

Duration.—The duration of the attack varies greatly, from a few minutes to several days. The spasm usually ceases abruptly, leaving a feeling of soreness in the abdomen, while there is enjoyable relief from suffering. Colic, when violent or intractable, may terminate in enteritis, in peritonitis, and, especially in children, in intussusception.

Diagnosis.—A pain moving from place to place, relieved by firm pressure and unattended by fever, separates colic from other affections, more particularly from those due to inflammation, in which pain is always aggravated by pressure.

Distension with spasm of the stomach may be distinguished from a similar condition of the colon, by the pain occupying a higher position in the abdomen (at or around the ensiform cartilage instead of—as in colic—the umbilical or hypochondriac regions), and by the percussion note elicited being deeper-toned and more prolonged than that which is produced by a distended colon; besides in colic the spasmodic contraction of the colon, producing borborygmi, may be traced by the hand, or may be even seen, and there is tenesmus.

It should be borne in mind that enteritis or peritonitis may follow colic, when the pulse, previously unaltered, may become frequent, hard and small, or frequent and soft, and the seat of inflammation becomes tender.

Prognosis.—Colic almost always ends in recovery, preceded by free evacuation from the bowels. Unfavourable signs are those arising from inflammation or intestinal obstruction.

Treatment.—In the first place the ætiological indications should be met. The irritating contents of the bowels should be dislodged by purgatives combined with sedatives, such as calomel (five or eight grains) or rhubarb (twenty grains) with opium (one grain), followed by repeated doses of some saline aperient, such as magnesiæ vel potassæ sulph., with tinct. of henbane or opium, and spirits of chloroform, until free action of the bowels is obtained.

A suppository containing half a grain each of hydrochlorate of morphia and extract of belladonna, or a subcutaneous injection of morphia, may secure immediate relief from pain before aperients have time to act. Large warm enemata often relieve quickly. Other suitable measures are—the warm bath, friction with warm oil or stimulating liniments, hot-water fomentations, steamed flannels, mustard or turpentine stupes, flannel bags containing hot chamomile flowers or heated sand, the stomach-warmer filled with hot water, large linseed and mustard poultice. The diet should be liquid.

In the prophylactic treatment the diet should be strictly regulated, lodgment of irritating solids and gases within the bowels should be prevented (*see* Constipation; Fæces, Retention of; and Flatulence), and the abdomen and feet should be kept warm by a flannel roller or belt and thick woollen stockings. George Oliver.

COLLAPSE.—Definition.—Collapse is a state of nervous prostration. When it is extreme, the vital functions are in a condition of partial, and sometimes nearly complete, abeyance. It may terminate in death, or be followed by gradual reaction and complete recovery.

Collapse and shock have usually been classed together, but it is not accurate to do so. It is

true that the ganglionic centres of the medulla oblongata are more or less profoundly involved in both, and that both possess many symptoms in common, dependent upon the derangement of function of one or more of these centres. Some confusion is attributable to the fact that shock is a term applied not only to a state or morbid condition, but to the cause which most frequently produces that condition—a violent impression or 'shock' to the nervous centres. *See* SHOCK. Collapse arises from many different causes, shock being one, of which collapse may be regarded as a final and extreme degree, and into which it often imperceptibly passes. Collapse, on the other hand, may occur under conditions where there has been no antecedent state of shock. Collapse presupposes previous nervous exhaustion, while shock may instantly appear in a healthy individual.

ÆTIOLOGY.—Any severe injury, especially if attended by profuse and sudden hæmorrhage, may terminate in collapse, such, for instance, as the rupture of one of the abdominal viscera, a penetrating wound of the chest or abdomen, or a wound of the heart or of a large artery. Extensive burns or scalds frequently give rise to typical collapse; and severe and prolonged pain is capable of causing it. Rupture of the heart or of an internal aneurism, if the patient do not immediately die, causes extreme collapse. Certain poisons, as tobacco and arsenic, will also produce this condition. It is the terminal stage of some diseases, as, for instance, of Asiatic cholera; severe drastic purgation also, or prolonged vomiting, from whatever cause, may occasion it. The pernicious malarious fevers and yellow fever often end in collapse. In the acute yellow atrophy of the liver symptoms of severe nervous disturbance, resulting in a species of collapse, sometimes suddenly supervene. Pyæmia, septicæmia, prolonged narcosis, frequently terminate in collapse.

SYMPTOMS.—The severity of collapse depends on the nature of the cause and the physical and mental vigour of the individual. It may vary from a moderate to an extreme degree. A moderate amount is seen in the course of fever and some other diseases, but this neither modifies the progress of the malady nor attracts the notice of the patient, causing chiefly peripheral coldness. From this trifling amount collapse may pass to the most intense form, where the patient scarcely differs in outward semblance from a dead body. A superficial inspection will fail to detect the existence of the functions of respiration and circulation. Vitality may be said to have reached its minimum. In well-marked collapse from severe injury or loss of blood the pulse at the wrist may be almost or wholly imperceptible, the heart's action scarcely audible, very rapid, fluttering, and irregular; the surface of the body, the face especially, is deadly pale and cold, and the skin moist with clammy sweat; the respiration is very feeble, slow, and irregular, accompanied by sighing or gasping inspirations at intervals; the expression and character of the face are lost; the features are sunken and relaxed; the eye is dull, glassy, staring, or languidly rolling about, and the conjunctiva perhaps insensible to the touch; the nostrils are dilated; the sensibility of the whole body is diminished; and the muscular debility is extreme. The patient lies on his back, without a trace of voluntary effort. If a limb is lifted it falls back again as if dead. Yet the consciousness and senses may be almost unimpaired; if roused by repeated questions the sufferer will with visible effort make a coherent though, probably, inadequate reply.

If relief be not given, the respiration may become slower and slower till each one appears the last, when a sudden sigh shows that life is still present; finally, the pulse and heart's action become more and more faint, and death results from pure asthenia. A condition closely resembling traumatic collapse is often witnessed in the last stage of cholera, when in an extreme degree the patient almost resembles a corpse save for the convulsive motions induced from time to time by the painful cramps. The surface is pale or bluish, covered with profuse sweat, but is at the same time cold to the touch. The hands and extremities are icy cold, the tongue is cold, and so also is the breath, which is gasping and paroxysmal; no pulse can be felt at the wrist; the eyes and features are sunken; the mind is apathetic, but nevertheless the consciousness may be perfect, and the patient able to respond to questions with a strong voice. Severe purging and tobacco-poisoning produce a condition extremely like that described as traumatic collapse.

Some cases of malignant fever terminate in collapse, which is characterised by extreme anxiety, pallor or lividity of the face and surface, coldness of the skin, sweating, and a small, frequent, and irregular pulse.

A decrease of animal heat, especially in the external parts, is characteristic of collapse. The temperature of the internal organs varies; and there may be collapse with high internal temperature. This occurs in cholera, intense fevers, and some forms of septicæmia; or the converse may obtain, as is frequently witnessed in the collapse of dissolution. Collapse from loss of blood differs from syncope, although the latter may be described as an acute and transient form of collapse. In syncope the prominent symptom is loss of consciousness, which in collapse may be almost or quite perfect.

For the PATHOLOGY and TREATMENT of collapse *see* SHOCK. WILLIAM MACCORMAC.

COLLAPSE, Pulmonary.—A condition in which the lung is simply more or less devoid of air. *See* LUNG, Collapse of.

COLLIQUATIVE (*colliqueo*, I melt).—A term which originated in the belief that in certain conditions the solid parts melted away, and were carried off as *liquid* discharges. The word is now generally applied to the copious sweats and diarrhœa which occur in certain wasting diseases, such as phthisis.

COLLOID (κόλλα, glue, and εἶδος, like).—A peculiar morbid product resembling in its characters glue or jelly, and found associated with cancer and other forms of new-growth. *See* CANCER and DEGENERATION.

COLON, Diseases of.—The colon participates to a varying extent in the lesions and

derangements of dysentery, typhoid fever, enteritis, peritonitis, and other affections. The special disorders to which it is most liable are intimately connected with its anatomical and physiological peculiarities. The colon is a distensible membranous tube, of large capacity, with chiefly solid contents, which are propelled slowly onwards by the muscular contractions of the walls. The moving force and the resistance offered to it are often too finely balanced, so that whenever the energy of the former is somewhat reduced, an accumulation of excretory products is apt to be determined. Hence arise retention of fæces and gases, constipation and consecutive evils, such as colic, colo-enteritis, or ulceration of the colon.

I. **Atony.**—Definition.—Loss of contractility of the walls of the colon, leading to accumulations and other sequelæ.

Ætiology.—The causes of torpor or atony of the colon are mainly those of constipation—sedentariness, indolent and luxurious habits, a sluggish and lymphatic temperament, old age, and general debility or exhaustion, as after a long and tedious illness. Whenever the walls of the colon are distended by solid or gaseous accumulations, the contractile power is apt to be enfeebled, leading to further retention and loss of tone.

Atony of the colon is an essential element in the pathogeny of constipation not depending on mechanical obstruction. Tympanitic distension of the colon from paralysis of the sympathetic nerve occurs in peritonitis and in fevers, *e.g.* typhus fever.

Symptoms.—Torpor of the colon may be indicated only by constipation. There are usually the ordinary signs of retention of flatus or fæces. In hysteria, and in inflammation of the bowels or peritoneum, flatus is apt to accumulate rapidly, and to produce great distension of the colon. Fæces may collect and form large tumours in any part of the large intestines, but especially in the cæcum and sigmoid flexure.

Fæcal and gaseous accumulations in the colon resulting from atony may produce the following effects, directly or remotely connected with them:—

(*a.*) *Local.*—1, Colic. 2, Inflammation of the walls of the colon, or of the mucous and submucous coats, and ulceration. 3, Disturbances from pressure: thus flatulent distension, and large fæcal accumulation encroaching on the cavity of the thorax and impeding the descent of the diaphragm, may cause dyspnœa or short and rapid respiration, palpitation and irregular action of the heart, with remote effects arising from a disturbed circulation in the brain, such as giddiness and headache; a distended cæcum or sigmoid flexure pressing on veins and nerves may induce œdema, numbness, and cramps of the right or left lower extremity. 4, Retarded digestion, derangement of the stomach and liver, and intestinal obstruction.

(*b.*) *General.*—The absorption of excrementitious matter is said to lead to wide-spread general effects, such as a sallow, earthy, or dirty complexion, lassitude, debility, offensive breath, loaded urine, &c.

Treatment.—Atony of the colon is usually a chronic disorder demanding prolonged treatment. The hygienic and dietetic rules laid down in the article Constipation require in most cases to be supplemented by medicines. The most satisfactory results follow a course of tonics, combined with aperients, such as iron, quinine, strychnia, belladonna, with aloes, colocynth, or rhubarb.

The purgative should be adjusted to each case, so as to secure no more and no less than a regular and efficient evacuation; and while the loaded colon continues to be thus relieved, the dose should be very gradually reduced.

This tonic-aperient course may be greatly aided by local stimulation of the colon, as by friction, kneading, electricity, cold-water compresses, or douches. The abdomen should be supported by a belt or roller. Bretonneau and Trousseau strongly advised a course of belladonna, giving gr. $\frac{1}{7}$ of the extract or of the powdered leaf as a pill in the early morning,—the stomach being empty,—then two such pills if in four or five days the bowels do not respond, and increasing the dose, but not beyond that contained in four or five pills, in twenty-four hours. A teaspoonful of castor oil may be given twice a week to aid this course of treatment. Flatulent distension of the colon in the elderly and in females at the climacteric period is often greatly relieved by the prolonged use of a pill containing compound assafœtida pill and nux vomica after meals. Electricity is sometimes used with benefit.

Tympanitic distension of the colon in peritonitis and in fevers is best treated by free doses of opium.

II. **Inflammation.**—Synon.: Colitis, colonitis, colo-enteritis; Fr. *colite*; Ger. *Entzundung des Schleimhautes des Kolons.*

An inflammation with ulceration of the mucous membrane and submucous connective tissue of the colon, producing lesions undistinguishable from those of dysentery, has been pointed out by Copland and Parkes. Colitis is said to be a non-specific local affection, commencing in the submucous tissue, and subsequently attacking the mucous membrane with its glandular structures—the primary seat of dysenteric inflammation. As in dysentery the inflammation induces gangrenous destruction and ulceration of the mucous membrane and underlying cellular tissue.

A *catarrhal* form of colitis is apt to occur in measles. 'It often happens that the morbillous catarrh of the intestines exhausts itself by attacking the large intestine, producing that special form of colitis characterised by tenesmus and glairy bloody stools.'[1] Inflammatory diarrhœa, particularly in children, often terminates similarly.

Colitis arising from *retained excreta* may involve the entire wall of a circumscribed portion of the colon, commonly the ascending colon and sigmoid flexure, or may be confined to the mucous and submucous tissues. In inflammation of the cæcum (typhlitis) the walls of the ascending colon are more or less implicated. In fæcal retention the mucous follicles of the colon may become obstructed, and the distension resulting therefrom may lead to inflammation and ulceration. Irritation of the mucous lining of the colon from the lodgment of fæces may extend to the lymphatic vessels and glands. The glan-

[1] Trousseau, *Clinique Médicale.*

dular enlargement cannot, however, usually be recognised during life. While the symptoms of tabes mesenterica may be traced to enlargement and obstruction of the mesenteric glands, set up by irritation of the intestinal tract, it is doubtful whether such results can follow a similar cause limited to the colon only.

Treatment.—The treatment of colitis consists in the local application of fomentations, poultices, opium enemata, or morphia suppositories; and in the use of gentle laxatives, such as castor oil, combined with sedatives, such as opium or henbane. The catarrhal form generally terminates in spontaneous recovery. Trousseau advises the use of albuminous injections, or of injections containing about half an ounce of water and nitrate of silver—from ¾ to 1½ grains,—or sulphate of copper or sulphate of zinc—from 3½ to 4½ grains.

III. **Displacements.**—The parts of the colon most liable to displacement are the transverse colon and sigmoid flexure—the former may descend as low as the pubes, and the latter may occupy any position between the left iliac region and the right side of the abdomen. Usually the meso-colon is elongated; there is adhesion between the displaced part and the new site; and, the longitudinal bands being elongated, the loculi are obliterated. Displacements are most apt to occur in those who have long suffered from constipation, retention of fæces, chronic dysentery, hernia, or from encysted or other tumours. They may lead to complete obstruction, and cannot usually be recognised with certainty during life.

IV. **Diverticula.**—A loculus of the colon from repeated accumulation may become so distended as to form a lateral appendix. Such a diverticulum when loaded with fæces may be felt through the abdominal wall as a distinct tumour, which may collapse when pressed between the fingers. George Oliver.

COLOUR-BLINDNESS. — A defect of vision, the subject of which is unable to distinguish certain colours. *See* Vision, Disorders of.

COMA (κῶμα, deep sleep).—A condition of profound insensibility. *See* Consciousness, Disorders of.

COMA-VIGIL (κῶμα, insensibility, and *vigil*, wakeful).

Definition.—A symptom, or set of symptoms, where continuous sleeplessness is associated with partial unconsciousness.

Coma-vigil occurs towards the end of diseases in which the nervous system is involved either directly or indirectly, especially where sleeplessness has been a symptom in the earlier part of the disease. Thus it frequently appears towards the end of an attack of typhus or of delirium tremens, when these are about to terminate fatally.

Symptoms.—The patient lies quiet with his eyes half-closed, inattentive to everything around, but not absolutely unconscious. If the eyelids are touched, they are closed, and perhaps the head is slowly turned away. The eyes have a dull, half-glazed look, and slowly follow any moving object near them. The pupils are neither much dilated nor contracted and they move under the influence of light, but very sluggishly. The mouth is generally somewhat open and dry, as are also the lips. The power of swallowing is much impaired; if a small quantity of fluid be put into the mouth, an effort is made after a short time to swallow it, and this effort is for a time successful; but after the symptoms have been present for some time, the effort is so feeble that no result follows. The patient lies mostly on the back; if turned on the side, he either remains as placed, or often slowly turns to the former position on the back. The limbs are occasionally moved a little, and if the hand or arm be raised, a slight resistance is offered. If the bladder or the rectum be emptied, there is slight consciousness of the act, as if a feeling of discomfort preceded it. The pulse is quick and weak. The respiration is weak, but otherwise normal. The symptoms continue unbroken throughout, nothing like natural sleep occurring.

Diagnosis.—Coma-vigil is distinguished from coma by the presence of a certain amount of consciousness, by the quick pulse, and by the absence of stertorous breathing. It is distinguished from concussion of the brain by the pupil not being contracted, by the history of the case, and by the absence of coldness of the skin, and of any sign of shock.

Prognosis.—The prognosis is unfavourable; coma-vigil is almost invariably a fatal symptom. It may last from a few hours to three or four days; from twenty-four to forty eight hours being the most common duration. It may deepen into actual coma; but more usually the symptoms change but little, save that the pulse becomes quicker and weaker, and the respiration more feeble, and death by asthenia then results.

Pathology.—As being little but a symptom, coma-vigil has strictly speaking no pathology. It seems to coincide with the gradual suspension through exhaustion of the functions of the nervous centres; the cerebral hemispheres being nearly if not quite inactive, while the action of the rest of the centres is kept up weakly but continuously, till the little remaining nervous power is exhausted, when death ensues. It differs from coma, inasmuch as in the latter, the medulla oblongata is the only centre left active, the functions of the rest being entirely suspended. It differs from concussion, inasmuch as the symptoms attending the temporary unconsciousness of the latter are more those of irritation than of pure suspension of function. R. Beveridge.

COMEDONES (*comedo*, I consume).—Synon.: Grubs.—This is the name applied to the little cylinders of sebaceous and epithelial substance which are apt to accumulate in the follicles of the skin, and to appear on the surface as small round black spots. When squeezed out they have the appearance of minute maggots or grubs with black heads, and thence have derived their name. They may occur in all parts of the body where sebaceous follicles exist, but are most common on the face, the nose, the neck and shoulders, the breast, and within the concha of the ears, in the latter situation often attaining a considerable size. The accumulation of this substance is due to want of

expulsory power of the skin, and to the slight impediment which is afforded by the aperture of the follicle to its exit; and when squeezed out it is found to vary in colour, in figure, and in density, according to the period of its detention. When recent, the comedones are soft and white, and modelled into an exact cylinder by compression through the mouth of the follicle; when impacted for a considerable time they acquire the yellow tint, the transparency and hardness of horn; and assume a bulbous figure from the dilatation of the follicle below the constricted orifice of the epidermis; and by their bulk they sometimes stretch the hair-follicle so far as to obliterate it completely. Besides their usual composition of sebaceous substance and epithelial cells, they frequently contain lanuginous hairs, and not rarely the entozoon folliculorum in its different phases of development. When they raise the pore into a minute pimple they have a similitude to acne punctata, and might be mistaken for that affection; whilst the black spot on the summit of conical acne is due to a comedo.

TREATMENT.—Comedones are generally associated with a weak state of the skin as well as of the individual; they are most frequently met with in young persons in whom the powers of the constitution are not yet established, and will be benefited by generous diet and tonic treatment. Locally, soap and water with plentiful friction and ablution will be found of great service; and, as an astringent to invigorate a debilitated skin, a lotion of perchloride of mercury, in emulsion of bitter almonds (two grains to an ounce) and spirits of wine.

ERASMUS WILSON.

COMPLICATION (*con*, with, and *plico*, I fold).—It is difficult to give a strict definition of what ought to be included under the term *complication*, but the word signifies the occurrence during the course of a disease of some other affection, or of some symptom or group of symptoms not usually observed, by which its progress is therefore complicated, and not uncommonly more or less seriously modified. The difficulty lies in determining what should be looked upon as essentially part of the original disease, and what as a mere accidental occurrence. For instance, many regard the cardiac affections which so often arise during the progress of acute rheumatism as a part of the complaint, others as complications. The same remark applies to the relationship of renal disease to scarlatina, as well as to numerous other cases.

Complications arise in different ways. They may, as just indicated, be considered as developments of the original morbid condition, resulting from the same cause and being more or less allied; or they are independent and accidental, of which an illustration is to be found in the association of ague with scurvy or dysentery, or in the co-existence of two or more of the exanthemata. The most important class of complications, however, are those which follow the primary disease as more or less direct consequences. These may further be induced in various ways. Thus, for example, in febrile diseases secondary lesions are liable to arise as a result of changes in the blood; a mechanical act, such as cough, may lead to complications in the course of phthisis and other pulmonary affections; cardiac diseases frequently bring about consecutive changes in other organs, by inducing obstruction of the venous circulation, or emboli may originate under certain conditions and produce their usual consequences. It is of great practical importance to be acquainted with the complications which are liable to be met with in the various diseases, and especially in those which are of an acute nature, in order that measures may be taken to prevent them, and that they may be recognized and treated at the earliest possible period, if they should occur.

FREDERICK T. ROBERTS.

COMPOUND GRANULAR CORPUSCLES. — Formerly these microscopic objects were regarded as of inflammatory origin, and as affording positive evidence of the occurrence of inflammation. Hence they were termed 'compound inflammation globules' (Gluge.) Almost all pathologists now, however, recognize the fact that they are not products of an inflammatory process, but result either from the degeneration of pre-existing cells, in which protein and fatty granules accumulate, or, perhaps, from the aggregation of granules originally distinct, which are present in abundance in degenerating tissues. They may even be formed out of the cells of morbid products, such as cancer. These compound granular corpuscles derive their name from the fact that they consist of a large number of minute granules aggregated together, and they either present a delicate cell-wall, or this cannot be detected. Occasionally there is an appearance of a nucleus in the centre.

FREDERICK T. ROBERTS.

COMPRESS.—Folds of lint or other material, which are used for the purpose of producing pressure, or as a pad by which hot or cold water or medicinal agents may be applied to the surface. In the latter case the compress may be rendered waterproof by being covered by a piece of gutta-percha tissue or mackintosh-cloth. *See* HYDROPATHY.

COMPRESSIBLE.—A term implying comparatively slight resistance, and applied specially to the pulse when it yields readily under the finger. *See* PULSE, The.

COMPRESSION of Brain. *See* BRAIN, Compression of.

COMPRESSION of Lung. *See* LUNG, Compression of.

CONCRETION (*con*, together, and *cresco*, I grow).—SYNON.: Calculus; Fr. *Concrétion, Calcul*; Ger. *Concrement.*

DEFINITION.—An unorganised body, formed either in one of the natural cavities or canals, or in the substance of an organ, by the deposit of certain solid constituents of the fluids of the part. In the widest sense of the term, Concretions comprehend Calculi.

ENUMERATION and CLASSIFICATION.—The following classified list includes the principal varieties of concretions:—

1. In *glandular structures*: lachrymal, sali-

vary, pancreatic, prostatic, seminal, urinary, hepatic, sebaceous, and mammary.

2. In the *circulatory system*: cardiac, and venous (*phleboliths*).

3. In *closed sacs*: peritoneal, and articular.

4. In *culs-de-sac*: bronchial, pulmonary, nasal, tonsillar, laryngeal, gastric, intestinal, præputial, uterine, and vaginal.

5. In the *substance of tissues* and new formations, especially in the nervous system—Corpora amylacea.

6. *Various*, such as the concretions on the teeth known as *tartar*.

General Characters and Number.—Concretions are generally firm or even of stony hardness; but they may be soft and friable. Their colour varies from white to black through shades of yellow and red. Concretions occur either singly or in groups; and their shape and size, as well as the character of their surface, vary considerably with their number; single concretions being more frequently rounded, larger, and less smooth than multiple specimens, which often present facets and polished surfaces. Many concretions are composed of concentric laminæ.

Composition.—The chief constituents of concretions are inorganic, that is, mineral salts, in a basis of organic matter. The bulk of the salts are carbonate and phosphate of lime and magnesia, with smaller quantities of alkaline compounds. The organic basis is composed of albuminous substances, mucus, cholesterin, and colouring matters.

Mode of Formation.—Concretions are generally derived from the solid constituents of vital fluids, whether physiological or pathological. In most instances the fluids are delayed in the natural passages by some abnormal obstruction or dilatation; and under such circumstances a chronic inflammatory condition of the walls contributes greatly to the probability of mineral deposit. Most frequently—as in the formation of the salivary and biliary concretions—the fluid portions of the secretion escape by the natural outlet or are absorbed, while the solid constituents are deposited; the particles being either agglomerated around a nucleus, or deposited in centripetal layers upon the surface of the cavity. In other instances—intracardiac, peritoneal, and articular, a nucleus is furnished by a portion of fibrin, blood-clot, or growth, on which fresh deposits take place, while calcification proceeds in the interior. In a third series, examples of which are found in the alimentary canal, the basis of the concretion consists of foreign or indigestible matter, such as hair, inspissated fæces, and masses of magnesia.

Effects and Symptoms.—The functions of a part occupied by a concretion are generally more or less impaired; the neighbouring tissues frequently atrophy; and inflammation and ulceration are common results, ending probably in the escape of the body. The concretion may be passed along a duct, and this process is generally attended with great pain; but concretions may remain where formed without causing symptoms. Occasionally they are spontaneously disintegrated or dissolved.

Treatment.—The treatment of concretions will be found discussed under the heads of the diseases of the organs where they respectively occur.

J. Mitchell Bruce.

CONCUSSION (*concutio*, I shake together). This term is used to indicate a condition induced by a more or less violent shaking or physical commotion of the general system, or of some particular organ, whereby serious symptoms may be induced, but no definite lesion can be detected to account for them. The nerve-centres are the parts most liable to be thus affected, concussion of the brain or spinal cord being of considerable moment, giving rise to more or less complete abolition of their functions, though this effect is usually only temporary. *See* Brain, and Spinal Cord, Concussion of. General concussion of the body is highly important at the present day, in connexion with railway accidents, after which persons seem to be uninjured, or only to be slightly shaken, but subsequently grave symptoms, associated with the nervous system, set in. *See* Railway Accidents, Results of

Frederick T. Roberts.

CONCUSSION OF BRAIN, SPINE, &c. *See* Brain; and Spinal Cord, Diseases of.

CONDYLOMA (Lat).—Definition.—Excrescences often found about the anus and organs of generation in both sexes. The term has been applied to simple cutaneous growths as well as to those of syphilitic origin; but since these latter are altogether due to a constitutional taint, and require a different treatment, they will be described separately under the heading of Mucous Tubercles, whilst the term *Condyloma* will be restricted to non-specific growths.

Symptoms.—Condylomata are generally situated in the neighbourhood of the anus and genital organs; and they result from the irritation produced by acrid vaginal or rectal discharges, or by the natural secretions in dirty persons. They consist in hypertrophy of the tegumentary tissues, and generally form smooth pendulous growths, but they may be flattened, irregular, and ulcerated on the surface. They are vascular, liable to become inflamed and painful from friction, and, as their position favours development, they may attain considerable size.

Treatment.—When all inflammation has been allayed, these excrescences should be removed with a pair of scissors; and to prevent their recurrence thorough cleanliness must be practised, and any discharge from the rectum or vagina stopped. If the parts be damp and perspiring they should be kept dry, and frequently dusted with zinc or bismuth powder, or bathed with some astringent lotion. No general treatment is of the slightest service.

George G. Gascoyen.

CONFLUENT (*confluo*, I run together).—Applied chiefly to a variety of smallpox and of other exanthemata, in which the eruption runs together or coalesces.

CONGENITAL (*con*, together, and *genitus*, begotten).—Existing at birth: a term generally applied to diseases or malformations, such as *Congenital Syphilis*, and *Congenital Clubfoot*.

CONGESTION (*congero*, I accumulate).—Overfulness of vessels caused by accumulation of their contents: generally applied to blood-vessels. *See* CIRCULATION, Disorders of.

CONIUM, Poisoning by. *See* APPENDIX.

CONJUNCTIVITIS.—Inflammation of the conjunctiva. *See* EYE AND ITS APPENDAGES, Diseases of.

CONSCIOUSNESS, Disorders of.—The disorders of consciousness are so numerous as to make it desirable briefly to consider them in one article, with a view to their classification and the better comprehension of their mutual relations. We shall, therefore, here group and arrange the various morbid conscious states, not aiming to produce a strictly scientific classification so much as one which will be practically useful.

1. **Exaltation of.**—Under this head may be ranged certain states of consciousness more or less distinctly bordering upon the unnatural, to be met with in persons under the influence of 'mental excitement' from various causes, as from sudden good news, or generally pleasant surroundings; also from a slight degree of poisoning by alcohol, opium, hashish, or other drugs; or from an early stage of some forms of insanity, or of delirium. In this state of mental exaltation the individual's powers of perception, apprehension, recollection, thought, emotion, and volition, would seem to be all more or less intensified, just as in that of hebetude or dementia they are diminished and consciousness is proportionately dwarfed.

2. **Perversions of.**—Many of the various defects here to be referred to are very partial in the extent to which they implicate consciousness, though others are general. In what is known as an *illusion* some object of sense is not correctly perceived; or, in other words, some sensorial impression is quite wrongly interpreted, as when a feverish or a maniacal patient, looking at some inanimate object, declares that it is a cat or a dog about to fly at him, or hearing even the slightest noise in any part of his room, interprets it to be the voice of some friend or imagined enemy. In the case of an *hallucination*, however, forms are declared to be seen, or voices heard (by a patient suffering from delirium tremens, for instance), where no appreciable external realities could have started the notion. And in these cases, it is not that the patient sees or hears without believing; he implicitly believes that the visions or voices which have been conjured up subjectively by the working of his own brain, have a real existence in the outside world. It is necessary to make this distinction because it is by no means uncommon in regard to the olfactory sense (especially in some epileptics), for odours or smells to be perceived which the patient soon comes to know are purely subjective or devoid of any external correlative.

Hallucinations and illusions, though occasionally existing alone, are quite commonly associated with a very important and more general derangement of consciousness, viz., *delirium*. This is a symptom very common in many fevers, in certain low states of the system, after severe frights, in inflammatory or other lesions of the brain and its membranes, as a result of some narcotico-irritant poison, or occasionally in a person who is recovering from an epileptic attack, or from the stupor sequential to a series of convulsive attacks. The state itself varies much in intensity. Three fairly distinct types exist. In (*a*) *low* or *muttering* delirium the patient lies still and more or less heedless of what is occurring around; or if heeding at all, the impressions which he receives give rise to erroneous perceptions (illusions) which are woven into the incoherent fabric of his rambling thought. In (*b*) *delirium tremens* the patient is more restless, tremors of the limbs and of the muscles of the face are often easily induced, hallucinations of sight and hearing are common, and the character of the delirium reveals that the patient is, to an unusual extent, possessed by fears, terrors, and other emotions of a depressing type. In (*c*) *wild* or *raving* delirium we have to do with a much more active state. The patient raves loudly and incoherently, more in regard to his fleeting dream-like thoughts than in connection with external impressions, of which he is more or less heedless. He is often violent in demeanour, and difficult to be restrained, persons in this state being capable of great and prolonged muscular exertion. The bodily activity accompanying this form of delirium is, in fact, just as characteristic as the great intensity of the mental processes. It is met with occasionally in some fevers, but more commonly in meningitis and in acute mania.

In its early stages delirium is principally noticed during the transition-period between waking and sleeping—at times, that is, when the nervous system most needs the reinvigorating influence of sleep. It is in these cases, too, that beef-tea or stimulants may for a time dispel all traces of the wandering thought. Whilst illusions and hallucinations enter largely into the mental activity of a delirious patient, *delusions* also are generally well-marked components. That is to say, the person becomes for a time possessed by an idea, notion, or fancy, for which there is no real warranty, though he believes and wishes to act as though it were true.

Somewhat allied to delirium in nature, though much lower in intensity as a mental process, is that *incoherence* of thought which is met with in many chronic maniacs, or in non-febrile patients suffering from various organic brain-diseases. In its slighter degrees this incoherence displays itself as mere 'rambling' talk; the patient has not sufficient brain-power to follow up the main subject of thought, and is frequently diverted into collateral channels. This, which is a natural state with some persons, may be distinctly indicative of disease in others whose mental power has previously been of a more vigorous type. At times the incoherence is seen to be governed principally by mere verbal suggestion, the patient being led away from point to point in new directions, owing to the associations of some word which has been used becoming for the time dominant. This state is often well seen in the sub-acute exacerbations of

chronic mania, though it may occur also where multiple softenings or indurations of the brain exist. At other times the incoherence is more absolute—wayward transitions from subject to subject, connected by no discoverable bond, rapidly following one another. The result in such a case is a mere unmeaning jumble of words, interspersed here and there with brief propositions having a limited significance of their own, though often wholly unrelated to that which precedes or follows.

Hypochondriasis is a perverted state of consciousness, having some resemblance to that of illusion, but in which some internal or visceral state becomes the starting-point of impressions (possibly not actually painful) which, when magnified and perverted as they are in the mind of the patient, fill him with false and gloomy apprehensions of various kinds. This perversion of consciousness is more generalised than that which exists in the case of illusion; and also instead of being a more or less temporary defect, it is one that may last for weeks, months, or even years. The state of mind of an hysterical patient is often not altogether different from that of the hypochondriac.

3. **Partial Loss of.**—Defects of this order are numerous and may exist in great variety. They may implicate almost equally nearly all the varieties of conscious mental activity, or some more than others. They may be either congenital, or acquired during the life of the individual.

In *idiotcy* we may have from birth defect in the power of concentrating the attention, a defective power of apprehension and of thinking, and a defective volition, shown alike by an inability to guide or control thought, and by a deficient vigour of bodily movement. Again, as a result of epilepsy, of organic brain-disease, or of injuries to the head, the patient may gradually lapse into such a condition from one of health, so as to become, as it is termed, 'demented.' Whilst this state of *dementia* may supervene at any age, it is much more common as a consequence of the brain-diseases frequent in advanced life. There is, moreover, a form known as *senile dementia*, in which without any typical disease, but as a consequence of impaired tissue-vitality and diffused degenerative changes throughout the nervous system, the mental faculties undergo a more marked degradation than is usually met with in old age. This condition in its minor degrees goes by the name of *hebetude*. In all such states or grades of idiotcy and dementia, we meet with an undue tendency to sleep in the day-time as a result of the listless and languid mental condition. This is but another sign of the general lowering of conscious vigour.

Here we must include, also, a peculiar group of conditions, having some alliance to one another, and which are all characterised by loss of consciousness to some extent, either partial in range or general. They are—*reverie*, *somnambulism*, *ecstasy*, *coma-vigil*, *catalepsy*, *hypnotism*, and *trance*. They are merely enumerated here, but are defined or described in their several places. In the latter of these conditions the loss of consciousness, in the ordinary acceptation of the term (viz. loss of perceptive power) is so absolute, that some may think it ought rather to be included in the next section. Loss of perceptive power, however, would not seem to be absolutely synonymous with loss of consciousness. There is good reason to believe, for instance, that where the influence of chloroform and other anæsthetics is not pushed to the fullest extent, a condition of *anæsthesia* intermediate between slight and profound is produced, in which, whilst there is absolutely no consciousness for external impressions, so that pain is altogether unfelt, there is still a certain amount of cerebral activity—as evidenced by rambling and indistinct speech on subjects altogether apart from what the surgeon may be doing. There is mental activity clearly, though the nature of this, as revealed by the patient's speech, may preclude the notion that pain is at the time being felt. Sensorial consciousness is blotted out, whilst a kind of ideational consciousness remains. We have an approximation to such a condition, also, in the case of *sleep* when dreams are rife. But here sensorial consciousness is not completely in abeyance. Again, in certain rare and anomalous epileptiform attacks we may find the patients, after the first paroxysms, bereft of some senses, though not of others. They may hear what is said by those around them, though they continue for a time quite unable to see or speak.

4. **Complete Loss of.**—In very profound sleep (*sopor*), in that prolonged form of it in which the person, if he can be momentarily roused, drops off again immediately (*lethargy*), and also in profound *anæsthesia*, there is complete loss of consciousness. The terms sopor and lethargy are now rarely used, and authors are not even agreed as to the precise state which should be designated by the latter word.

In *syncope* we have insensibility resulting from a cutting off of the proper supply of blood to the brain; whilst in *asphyxia* we have a like result following upon an interference with respiration.

A condition of *narcosis* or profound insensibility may result from opium or other drugs and poisons, amongst which alcohol is to be included as one of the most common producers of such a state. Or it may also be due to the deficient elimination of urinary products by the kidneys, when uræmic coma is produced.

Complete loss of consciousness exists for some time during the ordinary form of *epileptic fit*, or during an attack of convulsions; though in other epileptiform fits, not unfrequently met with—having some of the characters of hysterical convulsions—there seems to be a loss of sensorial consciousness only (loss of perception), whilst a certain amount of ideational consciousness remains. In *apoplexy* also there may be for hours or days a more or less profound loss of consciousness. In the less profound attacks, as well as after an epileptic fit or an attack of convulsions, the loss of consciousness is not complete, and we have a condition now commonly known as *stupor*. This state is also frequent as a result of concussion or other injuries of the brain, and it occasionally follows a severe fit of hysterical convulsions.

It may last for hours, days, or even weeks in some cases. In it the patient lies with his eyes closed, taking no heed of what is passing around, though he may show obvious signs of feeling when touched or pinched, and may be capable of being momentarily roused, so as to give a short monosyllabic answer, if slightly shaken or spoken to in a loud voice. On these occasions, signs of impatience are often shown. Though such a patient will not ask for food, he will often drink freely when it is offered. He will of his own accord, when his bladder is full, sometimes get out of bed, find the chamber-pot, use it, and return to bed without saying a word—and then speedily relapse into his previous state of stupor. When the insensibility is more profound, both urine and fæces are passed incontinently.

The state just spoken of is referred to in this section because it is so intimately allied to and connected by all sorts of transition conditions with another, known as *coma*, in which the loss of consciousness is more complete and absolute. There are different degrees of stupor and there are different degrees of coma; the former is commonly spoken of as slight or deep, whilst a comatose condition, coma, and profound coma (the latter being what the older writers termed *carus*) are the phrases ordinarily used to denote the increasing insensibility of the graver state, which is more especially characteristic of the apoplectic condition. Coma may result from long-continued exposure to cold, from sun-stroke, from poisons of various kinds, from erysipelas of the head and face, from inflammations of the meninges, multiple embolisms, the effects of hyperpyrexia, or from cerebral hæmorrhage. The most common cause of very profound coma is cerebral hæmorrhage (apoplexy). In this condition the breathing is often loud and stertorous, and consciousness is entirely obliterated, so that there is an utter absence of reflex movements when a limb is pinched or when the conjunctiva is touched. The patient in the deeper forms of coma often cannot be roused at all, even for a moment, and if this state does not terminate in one way or another before the expiration of twenty-four hours, or if it does not gradually pass into one of mere stupor, a fatal result may be considered imminent.

H. Charlton Bastian.

CONSTIPATION (*con*, together, and *stipo*, I cram).—Definition.—Infrequent or incomplete alvine evacuation, leading to retention of fæces.

Ætiology.—The causes of constipation may be *local*—an impediment to the onward movement of the fæces in the large intestine or from the rectum; or *general*—pertaining to habits, diet, and other conditions.

Local.—These include:—(*a*) Lesions inducing narrowing of some part of the large intestine. (*b*) Collections of scybala, intestinal concretions, &c. in the cæcum, sigmoid flexure, or rectum. (*c*) Pressure on the rectum, by uterine fibroid or ovarian tumours, uterine displacement, the gravid uterus, or an enlarged prostate. (*d*) Defæcation thwarted, as when the expiratory abdominal muscles are enfeebled, as in pregnancy, especially when repeated or after twins, obesity, old age, or in some painful affection of the abdomen, such as rheumatism of the abdominal walls and diaphragm, chronic dysentery, piles, anal fissure. (*e*) Feeble contraction of the intestinal muscular fibres, as in distension of the large intestine or a portion of it by gas, fæces, or lumbrici, inflammatory affections, lead-poisoning, senile atrophy, or in delicate females with lax muscular fibre (*see* Colon, Diseases of). (*f*) Pain in the pelvic viscera and probably elsewhere may induce paralysis of the sympathetic nerves supplied to the intestinal walls; thus may be explained obstinate constipation in painful uterine and ovarian diseases, which cannot be accounted for by pressure on the bowels or otherwise.

General.—The general causes of constipation are:—(*a*) Sluggishness of function—lymphatic temperament, anæmia, especially with amenorrhœa; or disposition to great activity of the muscular and nervous system. (*b*) Certain habits, namely, sedentariness; too great muscular activity; mental application, especially when excessive or prolonged; the continued use of aperients or enemata after the relief of temporary constipation; habitual disregard of, or hurry in the act of defecation; prolonged hours of sleep; the excessive or even moderate use of alcohol, tea, tobacco, or opiates. (*c*) Dietetic errors.—Diet too nutritious—leaving little intestinal residue—or poor and insufficient; improper feeding, especially in infants and children; the use of indigestible substances, such as cheese, nuts, or cucumber.

Constipation is frequently a prominent symptom in diseases of the stomach; of the liver; of the heart, inducing congestion of the portal system and of the nervous system: as well as in connexion with diabetes, excessive perspiration, prolonged lactation, and discharges.

The causes of constipation are such as evidently induce one or both of the following conditions.—1. Dryness and hardness of the contents of the large intestine from deficient secretion, or too active absorption of fluid from the intestinal tract. 2. Impaired contraction of the muscular fibres of the large intestine.

Description.—In constipation the evacuations are infrequent, solid, deficient in quantity, and sometimes unusually offensive; they often consist of dry, hard, dark or clay-coloured masses or scybala. Defæcation is generally difficult or even painful. As a rule the depth of colour, and the scybalous character of the motions, are in proportion to the duration of the lodgment of fæces in the large intestine. Infrequency of defæcation regarded alone is an untrustworthy sign of constipation, or constipation demanding medicinal or other treatment, inasmuch as it often depends on individual peculiarity. Good health is consistent with wide departures from the ordinary rule—a daily evacuation; not unfrequently there is no relief from the bowels for several days or even for a week, and yet without inconvenience, so long as the infrequent defæcation is habitual, or can be ascribed to idiosyncrasy.

The disturbances of function usually associated with constipation may be local, or extend to distant parts.

The *immediate* or *local* effects are such as may arise from retention of fæces:—signs of fæcal

collections in the cæcum, colon, sigmoid flexure, or rectum; irritation of portions of the intestine, indicated by colic, inflammation, ulceration, and perforation of the intestines; intestinal obstruction; pressure of fæcal accumulations on the intra-pelvic vessels and nerves, inducing menorrhagia, uterine catarrh, seminal emissions, hæmorrhoids, cold feet, neuralgia and numbness of the legs (Niemeyer). Constipation frequently exerts a pernicious influence on primary digestion, indicated by foul tongue, fœtid breath, anorexia, acidity, flatulence, biliary disturbance —even jaundice, and urine loaded with lithates.

The *remote* or *general* effects of constipation are lassitude of body and mind; headache, flushing and heat of head, vertigo; anæmia and wasting.

Treatment.—Constipation depending on individual peculiarity is rarely relieved permanently by treatment. The bowels, having acquired from early life the habit of infrequent evacuation, may be stimulated for a time, and are then apt to become more sluggish than before. In all cases the habit of the patient in this respect from childhood should first be determined, either as a warning against active or prolonged treatment, which may prove injurious, or as a guide to the adjustment of directions and remedies—affording as it does a limit which should not be over-stepped.

1. *Ætiological, Dietetic, and Hygienic Treatment.* —In treating constipation the causes should be met. Local causes—such as those inducing contraction of or pressure on some part of the large intestine, or feeble or ineffectual contraction of the intestinal muscular fibres or of the expiratory muscles, should first be eliminated. Habits disposing to constipation should also be corrected. Persons who are much preoccupied or careless are apt either to disregard the call to stool, or to perform the act of defæcation hurriedly, incompletely, and at irregular intervals. The sensibility of the nerves of the rectum becomes blunted by the constant contact of fæces. Hence the periodical removal of collections in the lower part of the large intestine is an essential element of the treatment. It is best when this can be done by well-timed natural efforts. The patient should be told to attempt defæcation every day after breakfast, and to persevere in so doing even when the result is occasionally or frequently unsuccessful. While straining to relieve the bowels, he may facilitate evacuation by pressing firmly the fingers in front and on each side of the coccyx, thus supporting the levator ani during contraction. Failing to obtain relief on the second day, a small cold water enema should be used to prevent further accumulation of fæces in the rectum, and to restore tone and sensibility to the blunted nerves. The enema should never be larger than is required to dislodge the motion from the pouch of the rectum—nor should it be warm; at first it may be tepid, afterwards cold. When evacuation is obstructed by the lower part of the fæcal mass becoming dry, relief may be obtained from emollient enemata and suppositories, such as infusion of linseed, decoction of marsh-mallow, solution of white of eggs, olive oil alone or in oatmeal gruel, or glycerine injected in small quantity into the rectum, and allowed to remain there for some hours; or by the use of suppositories at bed-time, consisting of cocoa butter, soap, or honey hardened by heat, either alone or combined with a stimulant to excite the flow of mucus into the rectum, or with extract of belladonna or of stramonium. Sedentary habits should be broken into. Exercise on foot or on horseback is specially to be commended, and carriage exercise to be avoided. While studying or reading the patient should walk about, and stand rather than sit at the desk. Gymnastics and out-of-door games are useful when a limited time only can be devoted to exercise. Excessive and exhausting exertion should be avoided. It is generally advisable to recommend early rising and cold bathing in the morning. In different cases one or other of the following may be found serviceable: a shower- or sponge-bath containing vinegar, baysalt, or consisting of sea-water, or a cold sitz bath; douches directed to the abdomen; a cold water compress applied to the abdomen during the day or night or for three or four hours in the morning; friction or kneading in the course of the colon every morning and when at stool; an abdominal belt (flannel or elastic) —especially if the abdomen be pendulous. The interrupted current of electricity has been successfully employed as a special excitor of the muscular fibres of the intestines or of the abdominal wall.

Diet. — Vegetable should predominate over animal food. Greens (cabbage, lettuce, &c.) are useful, as well as fruits, which should be ripe, and taken on an empty stomach. Prunes or figs stewed in olive oil, or infusion of senna, prune-pulp, oils and fats, such as cod oil or olive oil, are also serviceable when they do not disturb the digestion. Bread made of bran (or three parts flour and one part coarse bran), of corn-meal, or of cracked wheat; oatmeal porridge; or wheat ground in a coffee-mill, boiled and salted and served like rice, only less thick, may assist in preventing constipation; if there be acidity and other symptoms of dyspepsia, however, these indigestible articles of diet should be avoided. Tobacco-smoking after meals in moderation sometimes relieves constipation. Cold water or carbonic acid water—a tumblerful at bed-time, or preferably on rising in the morning, may be useful. Much must be left to individual experience; sometimes coffee, or beer, or cider answers best. As a rule farinacea, astringent wines, and tea increase constipation.

2. *Medicinal Treatment.*—When dietetic and hygienic directions fail, they require to be assisted by medicinal agents. The ends to be secured are threefold:—1. To evacuate fæces and gases which, distending the large intestine, thwart peristaltic action. 2. To tone the walls of the bowel, and thus prevent reaccumulation of fæces and the products of their decomposition. 3. To increase the flow of intestinal mucus. Remedies are usually variously combined for these purposes, and should be carefully adjusted to the requirements of each case, so as to meet the leading indications. Among the most useful aperients are aloes or its watery extract, rhubarb, colocynth, gamboge, and podophyllin, and either of these may be variously combined with extract of hyoscyamus or belladonna, extract of gentian,

extract of nux vomica, quinine, sulphate of iron, or ipecacuanha. The dose of the aperient should not exceed that required to secure gentle evacuation, and it varies with individuals. Purging exhausts torpid bowels, and perpetuates constipation. The bowels should not be pushed to more frequent relief than has been habitual with the patient from early life. The aperient, which should be varied in a prolonged course of treatment, should be very gradually dropped, while the intestinal tonics (belladonna, quinine, nux vomica, iron) are continued. The duration of treatment is prolonged until the aperient is almost entirely withdrawn. The remedies should be taken immediately or two or three hours after the principal meal. The treatment by belladonna, introduced by Bretonneau, was greatly prized by Trousseau (*see* COLON, Diseases of).

In anæmic subjects a firm and prolonged course of iron should be aided by aloes, nux vomica, and arsenic. In hæmorrhoidal complications aloes should as a rule be avoided, and laxative electuaries should be prescribed; in some cases, however, it tones without irritating the rectum. Flatulent dyspepsia and tympanites are indications for the prescription of nux vomica, which, however, will not radically cure constipation. In obstinate cases the most useful remedies are colocynth — tincture (Prussian Pharm.) 5 minims or more on sugar or in water three or four times a day, or 10 to 20 minims an hour before breakfast; extract or compound pill with small doses of croton oil, or with gamboge, elaterium, or other combinations; podophyllin with belladonna (Trousseau), ipecacuanha, and colocynth or aloes. A full dose of opium may liberate the bowels after the failure of the strongest purgatives, and constipation depending on inhibition of the sympathetic nerve from pain, will be relieved by opium with belladonna. Enemata, when frequently required, should be small in quantity, and at first tepid, then cold; for occasional use for the purpose of clearing away fæces loading the large bowel, they should be large (from two to six pints) and warm (*see* FÆCES, Retention of). The frequent use of large warm injections is injurious. Purgative waters, such as the Friedrichshall, Pullna, Hunyadi, or Carlsbad waters, given occasionally in small doses with warm water in the early morning, are often valuable adjuvants to a well-organised course of treatment. Constipation cannot, however, be cured by a course of saline purgatives, and may be greatly aggravated by it.

Numerous other drugs have been recommended in the treatment of habitual constipation, among which are nitric acid; arsenic with food in debilitated anæmic females, in the sedentary, or the old; tincture of benzoin—20 minims thrice daily; tincture of colchicum—a few drops after each meal; carbonate of iron; compound liquorice powder with sulphur—a teaspoonful at bedtime in water; tincture of veratrum viride—3 minims four or five times a day; or ox-gall dried, in pills.

GEORGE OLIVER.

CONSTITUTION.— SYNON.: Diathesis, Habit, Conformation of body. Fr. *Constitution*; Ger. *Leibesbeschaffenheit.*

The constitution may be *sound* or *unsound.* A sound constitution may be defined as the harmonious development and maintenance of the tissues and organs of which the body is made up. It originates with the union of a healthy sperm and germ cell, continues with the growth of the product under the most favourable conditions to adult life, and becomes gradually enfeebled with advancing age by the process of natural decay.

The constitution may be unsound in consequence of *deficient vitality.* This deficient vitality may be general, as is sometimes observed in the children of parents one or both of whom are in advanced life, or whose vitality on one side or the other has been reduced by excesses, such as alcoholic or venereal. Exhausted vitality from prolonged disease, *e.g.* phthisis or tertiary syphilis, affecting either parent, may determine the death of the offspring at an early period from mere failure of nutrition, or may cause it to succumb to acute disease not not necessarily associated with any inherited tendency of a special kind. The deficient vitality may be restricted to certain tissues or organs, viz., those concerned in the nervous, vascular, respiratory, or digestive systems. Thus amongst the most strikingly hereditary of diseases are those of degeneracy, such as emphysema, structural heart-diseases, atheroma of vessels, certain kidney-diseases, &c. Rightly interpreted, these diseases are of the nature of premature senility, attacking certain tissues or organs—as it may be seen to attack the hair or the cornea —from some inherent defect in their vitality.

The constitution may, in the second place, be unsound from some definite *inherited* form of disease. Although the constitution of an individual begins with his life, it is nevertheless the resultant of the constitutional peculiarities of many antecedents. This being so, tendencies to disease may date far back in the pedigree, to be called forth from time to time by favouring circumstances. We need, however, practically only go back a few generations in inquiring for those diseases which are well recognised as being hereditary. These form one section of the group of *constitutional diseases.*—Congenital syphilis, gout, scrophulosis, tuberculosis, cancer, asthma, and certain neuroses are all diseases which are apt to appear at certain periods of the life of the offspring, in consequence of some specific inherent defect of blood or tissue derived from his progenitors.

The constitution may, thirdly, become unsound at any period *subsequent to birth.* (*a*) This may be due to the surrounding conditions of life being evil. Deficient or impure air, insufficient or improper food, defective sunlight, over-work, intemperance, &c., may injure the constitution and give rise to diseases whose constitutional nature is sometimes strikingly shown in the tendency of some of them to become hereditary. Rickets, phthisis, and scrofula are examples. (*b*) The introduction of certain poisons into the system affects the constitution profoundly, and in some cases permanently, after the more obvious effects of the poisons have passed away. All the acute specific zymotic diseases, including vaccinia, would come under this category. They render the organism, for a long period or for life, proof against subsequent

attacks of the same disease. Only in certain cases, however, can the soundness of the constitution be said to be *impaired* by such diseases, and then it is usually through the occurrence of sequelæ. R. Douglas Powell.

CONSTITUTIONAL DISEASES. — These may be regarded as diseases generated from within, in the course of the wear and tear, nutrition and waste of the body, in consequence of innerent or acquired weakness in its construction.

The applicability of the term 'constitutional' to disease is sufficiently explained in the preceding remarks on 'constitution.' The term may, however, be associated with a group of so-called 'general' diseases, in opposition to that which includes 'zymotic' or 'specific' diseases, which are generated by the introduction of some definite poison from without.

In our present state of knowledge, however, no very rigid lines can be drawn to separate local, general, constitutional, and specific diseases from one another. *See* Disease, Causes of.

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CONSTRICTION (*constringo*, I bind together).—A narrowing, to a limited extent, of a canal or hollow organ, due either to a textural change in its walls, or to the pressure of a band surrounding it.

CONSUMPTION (*consumo*, I waste).—This is a term for any wasting disease, but it is generally applied to pulmonary phthisis. *See* Phthisis.

CONTAGION.—The word *contagion* is applied in pathology to the property and process by which, in certain sorts of disease, the affected body or part causes a disease like its own to arise in other bodies or other parts; and the Latin word *contagium* is conveniently used to denote in each such case the specific material, shown or presumed, in which the infective power ultimately resides. *See* Zyme and Zymosis.

The property of contagiousness belongs to a very large number of the diseases which affect the *human* body. And in more than this direct way the property is of great interest to mankind. Contagiousness of disease is a fact not only for man, but apparently for all living nature; and the influence of contagion in spreading destructive diseases among *domestic animals*, and among those parts of the *vegetable kingdom* which contribute to the nourishment of man, is such as to make it of immense social importance that the laws of contagion should be well studied and understood. Further, just as contagion in the case of *living* bodies and their parts spreads disease from one to another, so, to an immense extent, in the case of certain matters which, though of organic origin, are *not living*, it spreads various processes of decay. The so-called 'fermentations' which yield alcohol and vinegar, as well as that in which putrefaction consists, are contagious affections of the respective matters in which they occur: every cheesemonger knows that moulds of different kinds spread by inoculation, each in its own kind, from cheese to cheese; and if the Greek proverb 'grape mellows to grape' is true of the living fruit, the apple-loft gives analogous experiences of contagion among the fruit which is garnered.

The rationale of the word 'contagion,' as now used, is that the property is understood to attach itself essentially to a material *contact*; not necessarily that, when infection is spread from individual to individual, the contact of the individuals must have been *immediate*; but that in all cases there must have been such passage of material from the one to the other, as was in itself at least a *mediate contact* between them. And similarly, in those very instructive illustrations of the process of contagion which are furnished within the limits of a single diseased body by the propagations of disease from part to part of it, we can in general easily see that infection advances from part to part, either in proportion as part touches part, or in proportion as the one receives from the other the outflow of lymph or blood or secretion.

The various specific matters which effect contagion in the living body, the respective 'contagia' of the given diseases, seem all to have in common this one characteristic: that in appropriate media (among which must evidently be counted any living bodily texture or fluid which they can infect) they show themselves capable of *self-multiplication*; and it is in virtue of this property that, although at the moment of their entering the body they in general do not attract notice, either as objects of sense or as causes of bodily change, they gradually get to be recognisable in both of these respects. Now, the faculty of self-multiplication is eminently one of the characters which we call *vital*; and when it is said that all contagia are self-multiplying things, this is at least very strongly to suggest that perhaps all contagia are things endowed with life.

In order to any general consideration of the question thus suggested, contagia may conveniently (even if but provisionally) be distinguished as of two main classes, differing, or at present seeming to differ, from each other in their mode of action on the organisms which they infect: one class, namely, that of *Parasites*; and the other class, that of the true or *Metabolic Contagia*. Of this separation, so far as present knowledge seems to justify it, the assumed grounds are: that each true Contagium, in proportion as it multiplies in the body, *transforms*, in a way which is specific to itself and is different from the ways of other contagia, the bodily material with which it has contact; while, on the contrary, the Parasite, however much it may grow or multiply in the body, produces no qualitative effects specific to itself, but only such effects as are of common kind to it and all other parasites—indications, namely, of its *mechanical intrusiveness* in the parts which it occupies, and sometimes of the *drain* which it makes on its host's general nutritive resources.

A.—Of Parasites, in relation to processes of contagion, little needs be said in the present article. When an organism or part of it is, in greater or less amount, inhabited by other organisms, animal or vegetable, which subsist on it, or its food or refuse, it of course may be a centre of infection to other (if susceptible) bodies or parts, to which it can transmit live

parasites or their germs or seeds: for, when this transmission takes place, growth and self-multiplication, as in a colony, are the natural results which have to be expected; and in proportion as these occur, the newly-infected body or part gradually gets to suffer, like the old, from those particular derangements which make the type of parasitic disease. Some parasitic diseases, especially some of those of the skin, spread actively by direct contagion in ordinary intercourse; as for instance, scabies by the migration of its acari, and porrigo (among children) by the spores of its microphyte; and the spreading of such diseases where they exist may of course be to any extent facilitated by aggregation of persons and uncleanliness of personal habits. There are cases in which parasitic disease spreads from animal to animal only in proportion as the one feeds on the other, and eats it with parasites still living in it; or in proportion as live parasite-eggs or larvæ, discharged from the body of one animal, get conveyed with food (especially on raw herbage and in water) into the bowels of another. Considerable epidemics of trichiniasis in the human subject have been traced, chiefly in Germany, to infection from the pig; in cases where pork, abounding with trichinæ, has been eaten, as sausage-meat or otherwise, in a raw or imperfectly-cooked state: and in Iceland the very great sufferings of the human subject and the cattle from echinococcus have been traced to the influence of the dogs in spreading contagion from the slaughter-house, where they eat hydatidised offal, to the kitchen-gardens and water-sources and pastures, where they discharge tape-worm eggs from their bowels. *See* Porrigo, Scabies, Trichina, Hydatid, &c.

The diseased states which consist in being colonised by parasites are diseases of indefinite duration, tending in some cases to indefinite increase. In cases where the disease consists in the presence of swarms of blood-sucking or otherwise exhausting animal parasites, symptoms of the blood-drain will of course gradually arise; but otherwise the parasite, whether animal or vegetable, operates only as a mechanical presence. Skin and mucous membrane will be irritated in their superficial layers, and in some cases more deeply, by the animal or vegetable parasites which breed on or in them, just as they might be by dead mechanical irritants: solid organs having cystic entozoa in them will in like manner show evidence of irritation by encapsulating the colonists; and the surrounding tissue will of course suffer compression and displacement in proportion as the colonisation (*e.g.* in case of echinococcus) is compact and massive. In the case of trichiniasis —but, in our ordinary experience, in no other—the multiplication of the parasites, the burrowing of their young, and the general diffusion of these in the body, are processes of such extreme activity that, if the quantity of contagium taken into the stomach has been large, the innumerable local irritations suffice to make a very acute fever; but even in this extreme case, the merely irritative type, though exaggerated, is essentially preserved.

As different sorts of animals are notoriously liable to different sorts of parasites, so, even among animals of one sort, as for instance in the human kind, the liability of different bodies to receive particular parasite-infections, does not seem to be quite equal for all. Especially, the vegetable parasites seem to have their affinities determined or modified by the general state of health of the recipient; and there are cases in which it looks as if there ran in particular family-lines (perhaps with some slight chemical idiosyncrasy) a special liability to particular intestinal worms. There, however, is no reason to believe that in regard of the more important animal parasites, as particularly of trichina and the tæniadæ, the susceptibility of individuals to attacks is other than universal and practically equal.

B.—The true or metabolic contagia (to which the rest of the present article will exclusively refer)—the contagia which, in their respective and specific ways, operate *transformingly* on the live bodily material which they affect, are perhaps the most important of all the incidental physical influences which concern mankind. Whether they may all, at some time hereafter, admit of being named, like the parasitic contagia, in terms of biological classification, is a question which needs not in the first instance be raised; for meanwhile the identity of each separate true contagium is settled in experimental and clinical observation by the uniformity of the operation of each on any given animal body which it affects. Each of the diseases propagates itself in its own form in as exact identity, as if it were a species in zoology or botany; and in each such repetition of the disease there is a multiplication—always a large, and sometimes an inconceivably immense multiplication, of material which has the same infective property. Evidences innumerable to that effect are under daily clinical observation in this climate in instances of smallpox, measles, scarlatina, whooping-cough, enteric fever, mumps, typhus, syphilis, cowpox, diphtheria, erysipelas, hospital gangrene, purulent ophthalmia and gonorrhœa, venereal soft-chancre and phagedæna, &c.: for, barring fallacies, no man ever sees any one of those diseases produced by the contagium of any other of them; and any man who has before him a case of any of them can see that, however minute may have been the quantity of contagium by which the disease was started, the patient's diseased body (part or whole) yields for the time an indefinitely large supply of the specific agent. It is more or less habitual to some of the diseases that the infectedness of the patient is first made known to the observer by such *general pyrexia* as tells of change already far advanced in the circulating mass of blood; and it is only after this has shown itself, that other symptoms, adding themselves to the fever, complete the more or less complex type which establishes the identity of the disease. But in many of the diseases it may be the case (either naturally or as result of experimental infection) that the first, and in some diseases the main or even the only, effects of the contagion are *local changes*, passing where we can from the first observe them; and the broad facts of metabolic infection, as regards waste of bodily material with concurrent increase of contagium, are, in many such cases, among our most familiar experiences. Most instructive, too, are the facts of contagion which are to be learnt in the study

of tubercle: the contagium, introducible either by tubercular and certain septic inoculations through the skin, or internally by the infective action of the milk or diseased organs of tubercular animals if taken as food; and the contagium, when introduced, gradually spreading as it multiplies, and as lymph and blood carry it from the first infection-spot to other organs which now will repeat the process. And similarly in cancer (though the primary disease is at present of unknown origin and cannot be created by experiment) the repetition of the primary disease in secondary and tertiary propagations in the body of the sufferer is one of the most striking of all evidences of contagion; because of the great number of structural types which pass under the name of cancer, and the fidelity with which each of them is reproduced in the organ to which the contagion extends. A further fact of contagion, deserving notice in the present context, is the local spread of certain of these processes by continuity of tissue; as, for instance, in the continuous extension of phagedæna or hospital-gangrene from any centre of first inoculation, or of tubercular softening or cancer at the place where it begins: a mode of extension which indicates successive infective actions of matter on matter in spheres of ever-widening circumference;[1] and the like of which, but in rudimentary degree, may be traced in the areola of any acute inflammation.

In the physiology of the metabolic contagia no facts are more characteristic or more important than those which show the RELATIVENESS of particular contagia to PARTICULAR RECEPTIVITIES of body. First, and in intimate connexion, as would seem, with a *chemical electiveness* of action which will presently be imputed to contagia, there is the preference which some particular contagia (however introduced into the system) show for particular *organs* of the body; so that, by the exercise of this preference, there is given to each of the diseases its own set of clinical and anatomical characters. Compare, as instances in this point of view, the respective local affinities of smallpox, enteric fever, mumps, syphilis, hydrophobia, &c.—Secondly, it may be noted that, in regard to some of the contagia, different *persons*, and particularly persons of different *family-stocks*, show original differences of susceptibility; original, namely, as distinguished from others, hereafter to be mentioned, which are acquired; so that, for instance, the severity with which scarlatina or diphtheria will strike in particular families contrasts with a comparative mildness of the same disease in other families, or perhaps even with cases of apparently complete personal immunity under exposure to the particular danger: and recent researches have seemed to suggest as possible that, in the very wide differences of degree with which tubercular disease prevails in different families, an essential condition may be, that the families have widely different degrees of original predisposition towards some of the septic contagia.—Thirdly, there is the extremely suggestive fact with regard to many of our best-known febrilising contagia, that they run a course of *definite duration*, and that in this course, provided the patient do not die, all present, perhaps all future, *susceptibility to the particular contagium is utterly exhausted from the patient*; so that re-introduction of the same contagium will no more renew that patient's disease than yeast will excite a new alcoholic fermentation in any previously well-fermented bread or wine. The inference from this fact seems unavoidable, that each such contagium operates with a chemical distinctiveness of elective affinity on some special ingredient or ingredients of the body; and that exhausting this particular material in febrile process, which necessarily ends when the exhaustion is complete, is the bodily change which the contagium 'specifically' performs.—Of not all metabolic contagia, however, can it be said that their operation runs so definite and self-completing a course. For, first, there are particular *acute infections* which, as a rule, kill; either (as appears to be the case in splenic fever when affecting man) because of the extreme magnitude of the transforming process which the contagium sets up, or else (as appears to be the case in hydrophobia) because the elective incidence of the contagium is on an organ indispensable to life; so that in such cases there is in fact hardly such an event as passing alive through the whole process of the disease. And secondly, there are the *contagious dyscrasies* which are clearly characterised by their tendency to indefinite duration: syphilis, which oftener than not relapses in successive outbreaks, and often as years pass invades the body more and more deeply, and may after all never during life be ended; and tubercle and cancer, which, with almost invariable persistence, will in general steadily advance month by month to infect more and more of the body till the process eventuates in death.

The transmission of various contagious diseases IN COMMUNITIES is of course greatly influenced, both in detail and in aggregate, by such differences of individual receptivity as were mentioned in the last section. Notably, as regards communities through which particular acute infections have had full run, fresh sparks of the contagium may find little or no fuel on which to act; and much new diffusion of the disease may not again be possible, till immigration, or births, or lapse of time operating in other ways, shall have reconstituted a susceptible population. And, given the susceptible population, circumstances of time and place are infinitely various (especially as regards quantity and quickness of personal or quasi-personal intercourse) in determining how far this population shall have particular contagia thrown in its way.

Also there are conditions, not primarily of a personal kind, which operate on a very large scale in determining the spread of some of the metabolic infections: giving to them respectively *at certain times*, in ways not hitherto understood, a *special increment of spreading-power*, and in some instances also *special malignity*: and thus enabling them respectively from time to time to come into comparative prominence in national life, and perhaps at once or successively in many different countries, in the form of so-called EPIDEMICS. Thus, it is matter of familiar

[1] Compare Tennyson's

'little pitted speck in garnered fruit,
Which, rotting inward, slowly moulders all.'

knowledge that the fevers which are most habitual to this country, scarlatina, measles, smallpox, enteric fever, are of nothing like uniform prevalence,—that scarlatina, for instance, will be three times as fatal in one year as in another, and that smallpox is liable to even greater exacerbations: and it is known that temporary differences of this kind are not exclusively local,—that, for instance (to quote a late official report) 'the epidemic of smallpox which began in England towards the close of 1870 and terminated in the second quarter of 1873 was part of a general epidemic outbreak of that disease, of world-wide diffusion, marked wherever it occurred by an intensity and malignity unequalled by any previous epidemic of the disease within living memory.' The wider the survey which we take of epidemiology, the more certain it becomes to us, that, outside the conditions which are independently personal or local, there are *cosmical conditions* which have to be considered. Doubtless there are great epidemiological facts—such, for instance, as the first spreading of smallpox to America, or in our own times the increasing frequency of Asiatic cholera in Europe, which may be ascribed to novel conditions of international intercourse: but there are others, equally great, to which apparently no such explanation can be applied. For what reason it is that cholera every few years has its definite fit of extension in India,—or why diphtheria, which scarcely had a place in history till it overran Europe in the 16th century, and which since then had been rarely spoken of, began again some twenty-odd years ago to be comparatively important in England,—or why the plague of the Levant has for the last two centuries been so unfamiliar to us,—or why the yellow fever of the Mississippi has in particular years raged furiously in parts of Europe,—or why our black-death of the 14th century, though apparently still surviving in India, has never but that once been in Europe,—or whither has gone our sweating-sickness of three centuries ago,—or whence have come the modern epidemics of cerebro-spinal meningitis: these, and many like questions, which cannot at present be answered, seem to be evidence enough that, in the making of epidemics, contagion and personal susceptibility may be factors in a partly *conditional* sense. Influences which are called 'atmospheric'—the various direct and indirect influences which attach to the normal succession and occasional abnormality of seasons, in respect of the insolation of our planet, and of the temperature and humidity of air and earth—are in general far too vaguely regarded as elements of interest in the present question, but are possible factors which no epidemiologist should omit from scientific consideration. For any definite knowledge which exists on the relation of particular conditions of season to the prevalence of particular epidemics, the reader is referred to the article EPIDEMICS, and to articles on the respective diseases.

In the PASSAGE of the metabolic contagia FROM PERSON TO PERSON various agencies may be instrumental,—bedding or clothing or towels which have been used by the sick, dirty hands, dirty instruments or other utensils, the washerwoman's basket, foul water-supply, stinking house-drains, contaminated milk or other food, the common atmosphere, &c.; but differences of that sort are only differences as to the *means by which such communication is established with a diseased body* as brings its products into relation with healthy persons; and the disengagement of *infectious products* from the bodies of the sick is pathologically the one influential fact. As regards the products which ought to be deemed infectious, the specially-diseased surfaces and organs of the patient, and the discharges and exhalations which they respectively yield, must always be regarded with chief suspicion; but suspicion, however much it may insist on them, must never disregard other sources of danger. Of some of the metabolic contagia we practically know, and of many of the others we may by analogy feel sure, that, when a given body is possessed by one of them, no product of that body can be warranted as safe not to convey the infection. Presumption against every part and product of the diseased body is by everyone readily admitted where there are vehement general symptoms of disease: but it is important to know that not only in such febrile states, but even in states of chronic dyscrasy, and even at times when the dyscrasy may be giving no outward sign, the infected body may be variously infective. Thus, in regard to constitutional syphilis, it is certain that the mere utero-catarrhal discharge of the syphilitic woman, or the sperm of the syphilitic man, or the vaccine lymph of the syphilitic infant, may possibly contain the syphilitic contagium in full vigour, even at moments when the patient, who thus shows himself infective, has not on his own person any outward activity of syphilis. Similarly, in regard to tubercular disease, experiment has proved beyond question that the milk of animals suffering from tubercle will, if taken as food by other animals, infect them through the intestinal mucous membrane: and there are independent reasons for believing that the tubercular contagium (like the syphilitic) will at times during the dyscrasy be contained in the seminal fluid, and that men, tubercular perhaps only in some degree which is not immediately important to themselves, may by that secretion convey fatal infection to women with whom they have conjugal relations.[1] Regarding many of the metabolic contagia, conclusive evidence exists that, when they are in operation in pregnant women, the fœtus will in general be infected by them; and this though the diseases (*e.g.* smallpox, cholera, syphilis) be of the most different pathological types: but with regard to pregnant animals affected with splenic fever it is noticeable that Brauell, in his extensive researches, found the blood of the fœtus not to be infective.

In general, each contagium has its own favourite WAY OR WAYS OF ENTERING THE BODY; and these preferences are not only of speculative interest, as attaching to varieties of nature and natural habits among the contagia, but are of obvious practical importance as measures of the widely different degrees in which the different contagia are qualified to spread in communities. Thus, *inoculation at broken surfaces* of skin

[1] See Dr. Weber, in *Clin. Soc. Trans.*, 1874.

or mucous membrane has long been known as the ordinary mode by which the infections of syphilis, hydrophobia, splenic fever, cowpox, and farcy or glanders, get admission to the body; and our best knowledge of some other infectious diseases (notably of tubercle) has been derived from inoculations intentionally made with their contagia for purposes of study. While probably all infections which tend to be of general action on the body can be brought into action in that way, and while some infections are not known to pass by any other mode of transmission, there are many infections which spread freely from subject to subject by *atmospheric and dietetic communication*; and the meaning of these preferences is hitherto not fully known. It seems that some contagia are so acted upon by air and water, that they seldom or never reach the body in an effective state by those common means of communication,—some hardly, if at all, by water, and some not by air except with very close intercourse; and further, that, of contagia which reach the body in an effective state, some require, while others do not require, that an abnormal breach of surface shall give them special opportunity for taking hold. In some of the cases where a disease can be propagated in both ways,—i.e., certainly in smallpox, and apparently also in bovine pleuro-pneumonia, the artificially-inoculated disease tends to be much milder than the disease otherwise contracted; but pathologically it is difficult to conceive any essential difference between those different modes of contagion. It may be presumed that, in the modes which are not by true inoculation, acts which are comparable to inoculation take place on internal surfaces; that, for instance, when particles of scarlatina-contagium are caught in the tonsils, or inhaled into the bronchi, or swallowed into the stomach, they begin by penetrating the texture of the mucous membrane, and by thus effecting as real an inoculation, with regard to the blood, as that which art or accident provides in other cases through the punctured skin. That previous abnormal breach of surface by artificial puncture or otherwise is not necessary to allow the infection of mucous surfaces is illustrated in ophthalmia and gonorrhœa; where apparently no other condition has to be fulfilled than that a particle of the blenorrhagic contagium shall be deposited on the natural surface of the mucous membrane. It deserves notice that, while a considerable number of the worst diseases of the domestic animals admit of being communicated to man by artificial inoculation atmospheric communication seems to be very inapt, if not absolutely unable, to infect man with any one of them; and in this connection it may be of interest to remember that syphilis, one of the most familiar of human infections, but hitherto not traced to any brute ancestry, differs from our other current infections in requiring inoculation to transmit it.

When any metabolic contagium enters the animal body, it requires an INTERVAL OF TIME, and in most cases a considerable interval, before its morbific effects can become manifest even to skilled observation. The period of latency or so-called INCUBATION varies greatly in different cases. In hydrophobia it is very rarely less than of one month, is certainly often of several months, and is said to be sometimes of years. In syphilis the inoculated spot remains generally for at least a fortnight, and may remain even as much as five weeks, without any ostensible change; and the roseola of the general infection will not be seen till some weeks later, when generally at least three months will have elapsed since the first inoculation. In the acute eruptive fevers, when their contagium is transmitted by air, the first changes which ensue on infection are not external, and we cannot be sure what early internal changes may take place; but in smallpox, the fever (which is the first overt sign) does not attract notice till about the twelfth day after infection, nor the eruption till two days later; and in measles the incubation-time, though perhaps less uniform, seems to be little (if any) shorter than that of smallpox. The septic contagia and the contagium of splenic fever seem to be of particularly quick operation; but even the most virulent septic contagium, when without admixtures which tend to complicate its action, will not begin sensibly to derange the infected animal till at least several hours after it has been inoculated. As regards the contagia last referred to, it is conceivable that the self-multiplication of the contagium in the form in which it proves fatal to life is a process which goes on continuously and uniformly from the moment of inoculation to the moment of death, and that the moment when signs of general derangement become manifest is the moment when this uniformly-advancing process has accumulated in the system a certain quantity of result:—but it does not seem easy to apply this explanation to the diseases of long incubatory period; and we can hardly conjecture what may be the latent processes—for instance of smallpox, during the first ten or more days after contagium has been received.

It is not yet possible to say, in any universal sense, with regard to the metabolic contagia, what is the ESSENTIAL CONSTITUTION of 'contagious matter,' or what the INTIMATE NATURE of the 'transforming power' which the particle of such matter exercises on the particles which it infects.—As regards the question of the FORCE, chemists, when they refer in general terms to the various acts which they designate *acts of fermentation*, allege that certain processes of change in certain sorts of organic matter induce characteristic changes in certain other sorts of organic matter, not by the common chemical way of double decomposition with reciprocally new combinations, but (so to speak) as a mere by-play or collateral vibration-effect of the chemical force which is in movement; and though language can hardly be more vague than this for any scientific purpose, it expresses clearly enough the conviction of experts that a certain great force in nature lies beyond their power even of definite nomenclature, much more of exact identification and measurement. In that most interesting, but most difficult and hitherto almost uninvestigated, branch of chemical dynamics, we are supposed to have our nearest clue to the scientific problems of the present subject-matter. It may be conceded that the 'contact-influences' which are dimly recognised

as causing the fermentatory changes of dead organic matter have apparent analogues in many of the morbific influences of contagion: for the changes which chemists call 'fermentatory' are all catalytic or disintegrative of the organic compounds which they affect; and when living protoplasm is brought by contagion into processes of *characteristic decay*, the analogy seems sufficiently close to justify the word *zymotic* in the naming of the nature of the process. But it must not be forgotten that, among immediate effects of contagion in the living body, are cases wherein the process (so far as we can yet see) is primarily not *catalytic* or *dis*-integrative, but, on the contrary, *anaplastic* or *con*-structive. Thus, when tubercle gives rise to tubercle, whether by secondary and tertiary infection in a single diseased body, or by infection from the sick to the healthy, each new tubercle which the contagion brings into being is a *growth-product* of the texture which bears it. And similarly, when the innumerable varieties of cancerous tumour propagate themselves by contagion, each after its special type, in the bodies of the respective sufferers, it is growth, not disintegration, which we first see. It would seem that in those cases of anaplastic 'contact-influence' something far beyond the analogy of chemical fermentations must be involved; and, in view of some of them, the physiologist has to bethink himself of the analogy of that 'contact-influence' which becomes the mainspring of all normal growth and development, when the ovum receives spermatic impregnation.—As regards the ultimate ORGANIC CONSTITUTION of the several metabolic contagia—(each of them of course abstracted from accidental admixtures, and seen or conceived in the smallest and simplest units of quantity and quality in which its specific force can be embodied)—modern research seems more and more tending to show that the true unit of each metabolic contagium must either be, or must essentially include, a *specific living organism, able to multiply its kind.* For with regard to those other contagia (as we may properly call them) which spread fermentatory processes in common external nature, and of which it is as clear as of the morbific contagia that they multiply themselves in proportion as they act, it seems to be established beyond reasonable doubt that the 'self-multiplication' of each of them as it acts is the infinite multiplication of a specific microphyte; and that this microphyte (acting apparently by means of a matter which it produces and from which it can be mechanically separated) is the essential originator of the fermentation.[1] This being the case in regard of those fermentations, it seems probable that the same is in substance true of the specific morbid changes which extrinsic contagia produce in the materials of the living body: probable, namely, that low, self-multiplying organic forms, specific in each case for the particular disease which is in question, are essential to each morbid poison; that the increase of each contagium as it acts is the characteristic self-multiplication of a *living thing*; and that *this* (however obscure may yet remain its mode of operation) is the *essential originator of change* in the affected materials of the diseased body. The fact that low organic forms of the sorts now spoken of have often, or generally, been seen in the morbid products and tissues of persons with zymotic disease, would not by itself be a proof, or nearly a proof, that the forms are causative of the morbid change: for obviously they might be mere attendants on the necrosis and decomposition of bodily material, availing themselves of the process (just as certain insects would) to feed and multiply: and in many of the cases in which micrococci have been seen in morbid material, no direct proof could be given that the meaning of their presence was more than that. There are, however, some cases in which this proof has been completely established; and though such cases are at present but few, the significance of each of them in aid of the interpretation of other cases is of the highest importance. The researches of successive able observers in regard of the splenic fever of farm-stock, and those of Dr. Klein in regard of the 'pneumo-enteritis' (as he names it) of swine, have shown that in each of these cases the microphyte which attends the disease is botanically specific; that it and its progeny can be conducted through a series of artificial cultivations apart from the animal body; and that germs thus remotely descended from a first contagium will, if living animals be inoculated with them, breed in these animals the specific disease. It is equally well known that the organisms (spirilla) which are found multiplying in the blood during the accesses of relapsing fever are botanically specific; but in regard to this disease, experimental proof has not hitherto been given that the spirilla, if separately inoculated, will infect with relapsing fever. Studies as complete as those which have been made in splenic fever and pneumo-enteritis will no doubt sooner or later be made in regard to many other of the diseases, but their progress will necessarily be slow; partly because the objects which have to be scrutinised, and to which specific characters have to be assigned, are so extremely minute, and often so similar among themselves, that none but very skilled and very patient microscopical observers are competent to pronounce on them; and partly again because the conditions of the case are such as to limit very closely the field within which the essential experimental observations can be made. Meanwhile, however, the two diseases, regarding which the larger knowledge has been obtained, must be regarded as highly suggestive in regard of other diseases of the same pathological group, and particularly as giving importance to fragments of evidence (not by themselves conclusive) which have been gathered of late years in studies of some of these other diseases. Eminently this is true of the large family of the septic infections—including on the

[1] The doctrine to which the words in parenthesis refer (that the microphyte is not itself the ferment, but the producer and evolver of the ferment) tends to bring the case of these ferments into parallelism with that of the chylopoëtic and other functional ferments which more highly organised creatures produce for the purposes of their own economy. In the latter case the distinction between the ferment-yielding live bodies (say certain gastric cells) and their not-live product (say pepsin) is already familiar.

one hand erysipelas and pyæmia with its congeners, and having on the other hand tuberculosis intimately associated with it; and almost equally it is true of enteric fever and cholera and diphtheria, and of the smallpox of man and beast. Thus, though it would be at least premature to say of these diseases that they certainly have as their contagia *microphytes respectively specific* to them, it seems at present not too much to say that probably such will be found the case; and if as much may not yet be said of many other diseases which are due to metabolic contagia, it must be remembered that the right lines of study relating to contagia in this point of view have not till within very recent times been opened.

Of the NATURAL HISTORY of the contagia, considered independently of the part which they play in the living body, there are hitherto only the beginnings of knowledge. The absolutely first origin of contagia may perhaps not be more within reach of scientific research than the absolutely first origin of dog or cat; but their nearer antecedents—the states out of which they come when first about to act on the living body, and generally the variations which they and the common ferments exhibit under natural and artificial changes of circumstance, are within easy reach of investigation; and those humbler studies are likely to give very useful results. For some of our cases we seem to have an instructive analogy in the facts which Professor Mosler has put together in explanation of the blue-milk contagium of dairies: facts showing that the omnipresent penicillium glaucum, if its spores happen to alight in particular (morbid) sorts of milk, will operate distinctively on their casein as an anilin-making ferment, rendering the milk blue and poisonous, and imparting to each drop of it the power to infect with a like zymosis any normal milk to which it may be added.[1] In our own more special field, pathologists have already learnt that certain of the so-called 'morbid poisons'—the contagia of erysipelas, pyæmia and tuberculosis, are intimately related to the common ferment or ferments of *putrefaction*; and that the most vehement of these contagia can be developed by the artificial culture of successive transmissions in the living body from the comparatively mild contagium of any *common inflammatory* process.[2]

Two other directions suggest themselves as likely to lead to fields of useful observation and experiment. On the one hand, in *comparative pathology*, and with the tracing of contagion from animal to animal, there is the possibility that at last some lower and relatively worthless order of animals may be found the starting-ground of fatal infections for higher orders; and this, perhaps, by contagia which in their former relations are of mere inflammatory significance. On the other hand, in *geographical pathology*, and with the tracing of contagion from place to place, local centres of contagium-origination may possibly be found, in which the contagium, before it enters the animal body, will show itself an independent microphyte of the earth, first operating on the animal body as the essential force in a local malaria. Some of the worst pestilences known to the human race—yellow fever, cholera, perhaps plague, and also some of the diseases of cattle, have in their history facts which suggest that sort of interpretation: the supposition, namely, that certain microphytes are capable of thriving equally (though perhaps in different forms) either without or within the animal body; now fructifying in soil or water of appropriate quality, and now the self-multiplying contagium of a bodily disease. In regard to our own common ague poison there seems every reason to suspect that its relation to soil is that of a microphyte; and though we know ague only as practically a non-contagious disease, we do not know that any little transfusion of blood from sick to healthy would not show it to be (in that way) communicable from person to person.

It needs hardly be said that exact scientific knowledge of the contagia, and of their respective modes of operation, is of supreme importance to the PREVENTION OF DISEASE. With even such knowledge of them as already exists, diseases which have in past times been most murderous of mankind and the domestic animals can, if the knowledge be duly applied, be kept comparatively, or absolutely, in subjection; and the fact that at the present time fully a fifth part of the annual mortality of the population of England is due to epidemics of contagious disease is only because of the very imperfect application hitherto made of that knowledge. In the present article it is not necessary to state in detail the practice which ought to be adopted in the various different cases of infectious disease; but briefly it may be said that one principle is at the root of all such practice, whatever the disease to which it relates. This principle, which of course becomes more and more important in proportion as the infection is dangerous, and as the persons whom it would endanger are many, is the principle of *thoroughly effective separation* between the sick and the healthy: a separation, which, so far as the nature of the disease requires, must regard not only the personal presence of the sick, but equally all the various ways, direct and indirect, by which infective matters from that presence may pass into operation on others. Especially as regards the diseases which make serious epidemics, the principle of isolation is not carried into effect unless due care be taken to thoroughly disinfect in detail all infective discharges from the sick, and all clothing and bedding and towels and like things which such discharges may have imbued, and finally, as regards certain contagia, the rooms in which the cases have been treated; and in order to secure these objects, it is essential in all grave cases to make such nursing-arrangements and such arrangements of the sick-room (whether private or in hospital) that no retention or dissemination of infectious matters will escape notice. It is likewise essential that all who attend on the sick should be careful not to carry contagion to other persons; as they may but too easily do, particularly in scarlatina and

[1] Virch. *Arch.*, vol. 43.

[2] See particularly Professor Sanderson's papers in successive yearly volumes of *Reports of the Medical Officer of the Privy Council* from 1868 to 1877. It concerns the second fact mentioned in the text to remember that apparently every 'common inflammatory process' includes more or less of textural changes which are necrotic and of septic tendency. See *Holmes's System of Surgery*, first edition article 'Inflammation.'

in certain traumatic and puerperal infections, if they omit to take special precautions against the danger. *See* articles QUARANTINE, DISINFECTION, and PUBLIC HEALTH, and those on the special diseases.

The SOCIAL CONDITIONS through which, in our own country at the present time, the more fatal infectious diseases are enabled to acquire *epidemic diffusion* are chiefly such as the following:—that persons first sick in families and districts, instead of being isolated from the healthy, and treated with special regard to their powers of spreading infection, are often left to take their chance in all such respects; so that, especially in poor neighbourhoods, where houses are often in several holdings, and where always there is much intermingling of population, a first case, if not at once removed to a special establishment, will almost of necessity give occasion to many other cases to follow;—that persons with infectious disease, especially in cases of slight or incipient attack, and of incomplete recovery, mingle freely with others in work-places and amusement-places of common resort, and, if children, especially in day-schools; and that such persons travel freely with other persons from place to place in public conveyances;—that often, on occasions when boarding-schools have infectious disease getting the ascendant in them, the schools are broken up for the time, and scholars, incubating or perhaps beginning to show infection, are sent away to their respective, perhaps distant, homes;—that keepers of lodging-houses often receive lodgers into rooms and beds which have recently been occupied by persons with infectious disease and have not been disinfected;—that persons in various branches of business relating to dress (male and female) and to furniture, if they happen to have infectious disease, such as scarlatina or smallpox, on their premises, probably often spread infection to their customers by previous carelessness as to the articles which they send home to them; and that laundries further illustrate this sort of danger by carelessness in regard to infected things which they receive to wash;—that purveyors of certain sorts of food, if they happen to have infectious disease on their premises, by carelessness spread infection to their customers;—that streams and wells with sewage and other filth escaping into them are most dangerous means of infection, especially as regards enteric fever and cholera; and that great purveyors of public water-supplies, so far as they use insufficient precautions to ensure the freedom of their water from such risks of infectious pollution, represent in this respect an enormous public danger;—that ill-conditioned sewers and house-drains, and cesspools receiving infectious matters, greatly contribute to disseminate contagia, often into houses in the same system of drainage, and often by leakage into wells. Of the dangers here enumerated, there is perhaps none against which the law of England does not purport in some degree to provide. At present, however, they all are, to an immense extent, left in uncontrolled operation; partly because the law is inadequate, and partly because local administrators of the law often give little care to the matter; but chiefly because that strong influence of national opinion which controls both law and administration cannot really be effective until the time when right knowledge of the subject shall be generally distributed among the people, and when the masses whom epidemics affect shall appreciate their own great interest in preventing them.

Whenever that time shall come, probably the public good will be seen to require, with regard to every serious infectious disease which is apt to become epidemic, that the PRINCIPLES which ought to be accepted in a really practical sense and to be embodied in effective LAW, are somewhat as follows:—(1) that each case of such disease is a public danger, against which the public, as represented by its local sanitary authorities, is entitled to be warned by proper information; (2) that every man who in his own person, or in that of anyone under his charge, is the subject of such disease, or is in control of circumstances relating to it, is, in common duty towards his neighbours, bound to take every care which he can against the spreading of the infection; that so far as he would not of his own accord do this duty, his neighbours ought to have ample and ready means of compelling him; and that he should be responsible for giving to the local sanitary authority proper notification of his case, in order that the authority may, as far as needful, satisfy itself as to the sufficiency of his precautions; (3) that so far as he may from ignorance not understand the scope of his precautionary duties, or may from poverty or other circumstances be unable to fulfil them, the common interest is to give him liberally out of the common stock such guidance and such effectual help as may be wanting; (4) that so far as he is voluntarily in default of his duty, he should not only be punishable by penalty as for an act of nuisance, but should be liable to pay pecuniary damages for whatever harm he occasions to others; (5) that the various commercial undertakings which in certain contingencies may be specially instrumental in the spreading of infection—water-companies, dairies, laundries, boarding-schools, lodging-houses, inns, &c., should respectively be subject to special rule and visitation in regard of the special dangers which they may occasion; and that the persons in authority in them should be held to strict account for whatever injury may be caused through neglect of rule; (6) finally, that every local sanitary authority should always have at command, for the use of its district, such hospital-accommodation for the sick, such means for their conveyance, such mortuary, such disinfection-establishment, and generally such planned arrangements and skilled service, as may, in case of need, suffice for all probable requirements of the district.

Persons who are imperfectly acquainted with the scientific and social facts relating to the present subject-matter, or who have never seriously considered them, may think it would be over-sanguine to expect any general recognition of principles so peremptory as the above may at first appear to them; but, if so thinking, they would perhaps have under-estimated the rapidity with which knowledge is now increasing as to the common interests and mutual duties of mankind in respect of danger-

ous infectio is disease. Fourteen years ago, when the so-called cattle-plague or steppe-murrain was imported afresh, as a long-forgotten disease, into this country, and was found to affect very large pecuniary interests, primarily of the chief land-owners of the United Kingdom, and secondarily of other classes, an immensely valuable stimulus was given to the education of the country, and especially of its Legislature, in regard to the preventability of the infectious diseases. And the remarkable zeal and ability which have been shown, in providing adequate laws and admirable administrative arrangements against the diffusion of steppe-murrain and other infectious diseases of Farm-Stock, are not likely to be found permanently absent in relation to the interests of Human Life, when once the true bearings of the subject shall have got to be popularly understood. JOHN SIMON.

CONTINUED FEVERS.—CHARACTERS.—Under the name of Continued Fevers is included a group of diseases which have the following characters in common:—

1. They are attended with *pyrexia*, or a febrile condition sustained for a more or less definite period of considerable duration, without intermission or very decided remission, and not due to any local inflammation. That is, the fever is *essential*, and not merely *symptomatic*. The distinguishing feature of pyrexia is unnatural elevation of the temperature of the body, but there are other symptoms scarcely less constant—increased frequency of the pulse, thirst, loss of appetite, furred tongue, headache, chilliness, and—if the temperature is high—various manifestations of disturbance of the nervous system.

2. They are clearly due to the introduction into the body of a *poison from without*, and this poison is *reproduced in the system*, so that continued fevers are communicable directly or indirectly from the sufferer to others. This statement would not apply to simple continued fever so called; but simple continued fever, when not a mild or abortive attack of one or other of the specific fevers, has scarcely anything in common with them.

3. The continued fevers rarely affect the same individual twice. An attack is *protective against subsequent attacks* of the same fever. This is much less manifest in relapsing than in typhus and enteric fever.

4. The continued fevers have a more or less *definite duration*. A certain time intervenes between the exposure to the poison and the onset of the disease, which is called the period of incubation; and the disease is divisible into the stages of invasion, dominance, and decline.

5. In two out of the three continued fevers there is a characteristic *cutaneous eruption*.

ENUMERATION. — The continued fevers are typhus, enteric, and relapsing fever. Common continued fever, or febricula, often associated with them for the sake of convenience, resembles them only as consisting in pyrexia not traceable to any known local inflammation. It does not conform to the characteristics enumerated, and cannot be brought within any definition which applies to the true fevers.

DIAGNOSIS.—The continued fevers have to be distinguished from the intermittent and remittent fevers on the one hand, and from the eruptive fevers and some other diseases on the other.

1. From *intermittent* and *remittent* fevers they are distinguished clinically by the comparatively sustained high temperature; but were this all the continuous character sometimes assumed by intermittents and the remittent type occasionally seen in enteric fever—especially in children—would bring them close together. The essential distinction is that indicated under the second head, and is mainly ætiological. Both kinds of fever are due to a poison received from without; but while in continued fevers the source of the poison is for the most part a previous case of fever of the same kind, and the poison is generated anew in the subject of the disease, remittents and intermittents are of malarious origin, and the poison is never reproduced in the system, and therefore never communicated by the sufferer.

The formation of the specific contagium of continued fevers within the system during the disease is of course the cause of their spread by contagion. The mode of this spread is different for the different fevers. Typhus and relapsing fever are directly contagious in an eminent degree; the poison is contained in the emanations from the skin or lungs, and is capable of entering the blood of healthy persons by being breathed or swallowed; it may also be carried by fomites. Enteric fever, if directly contagious at all, is very slightly so; the contagium is apparently not given off in the breath or perspiration, but chiefly or exclusively from the bowels, and the disease is spread mainly by the contamination of drinking water, or, more rarely, by sewer gases or by the emanations from typhoid excreta, especially after long residence in sewers.

2. The distinctions between the continued and the *eruptive fevers* remain to be pointed out. They are of a very slight character. All the characters given of the continued fevers, including the occurrence of a cutaneous eruption, are common to them and the eruptive fevers. The differences are as follows:—

a. The liability to the eruptive fevers is almost universal in the absence of protection by a previous attack, and is little affected by the state of health of the individual, while the liability to continued fever is very variable in different persons, and even races, and is greatly influenced by external conditions. There is no parallel in the eruptive fevers to the predisposition to typhus and relapsing fever generated by overcrowding and famine.

b. The protective influence of a previous attack is more marked in the eruptive fevers, though not to such a degree as would constitute an important distinction. Instances of small-pox after a previous attack, or after vaccination, and second attacks of measles and scarlet fever, are not very uncommon.

c. While in the eruptive fevers the specific poison is considered to be invariably derived from a previous case, this cannot be said with the same confidence with regard to the continued fevers. It is true that in by far the largest proportion of attacks of typhus, enteric, and relapsing fevers the source of the poison can be

traced, and that as the experience and trained skill brought to bear on the search increase, the fewer are the examples in which it fails; but it cannot yet be said definitely that these fevers are not generated anew under certain conditions. The constancy with which typhus and relapsing fever follow in the track of overcrowding and starvation is suggestive of spontaneous origin; but in this country typhus is never so completely extinct that foci of infection are wanting, and epidemics of relapsing fever may be imported. Enteric fever, again, appears from time to time under circumstances which appear to exclude the possibility of the poison having been derived from a previous case, though in most instances of epidemic prevalence of the disease, there is conclusive evidence of specific and not merely general contamination of the air or water. It is not, however, necessary to enter upon this controversy here, or to do more than allude to the question whether or not their contagia are of the nature of organic germs. *See* CONTAGION; and ZYME.

The fevers will be fully described under their respective names. WILLIAM H. BROADBENT.

CONTRACTION, Muscular (*contraho*, I draw together).—A term applied to the action or to the shortening of a muscle from any cause, whether in health or in disease. *See* SPASM.

CONTRA-INDICATION.—Any circumstance which forbids the employment of therapeutic measures otherwise indicated.

CONTRE-COUP (Fr.), Counter-stroke.—An injury of a part opposite to and distant from that to which force is applied, as by a fall or direct blow. Contre-coup is chiefly observed in injuries of the skull.

CONTUSION (*contundo*, I bruise).—A bruise or injury of the soft parts without breach of surface.

CONVALESCENCE (*con* and *valesco*, I grow well.)—The *period of convalescence* signifies that period during which a patient is progressing towards recovery, and is returning to a state of health after having suffered from an illness. When the health has been completely restored, convalescence is said to be established, and the patient is regarded as convalescent. The word is used most commonly in association with fevers, inflammatory diseases, and other acute affections. Convalescence may be ushered in by a crisis, and become speedily established; or it may be very slow and protracted in its progress, which is also often interrupted by relapses, complications, or sequelæ. Patients frequently require careful watching and judicious treatment while becoming convalescent, as they are apt to retard or even prevent their recovery, and to lay the foundation for permanent disease by neglect of due precautions, especially as regards their diet. Much injury is not uncommonly inflicted by the injudicious administration of medicines, and the employment of other means which are supposed to hasten convalescence.

FREDERICK T. ROBERTS.

CONVOLUTIONS OF THE BRAIN and CORTEX CEREBRI, Lesions of.—The pathology of the cortex cerebri is a subject which, notwithstanding the extensive literature relating to cerebral disease, is still comparatively in its infancy. The older records and observations made while the idea was still prevalent, that the convolutions of the brain had no definite dispositions and relations, and that the various parts of the hemispheres were functionally equivalent, are not sufficiently exact to be made the basis of trustworthy clinical and physiological conclusions. Recent anatomical investigation into the topography and homologies of the cerebral convolutions, and the experimental researches of Hitzig, the writer, and others in reference to the results of electrical irritation of the brain, have directed greater attention to accurate topographical descriptions of the lesions of the cortex in connexion with observed clinical symptoms. As yet, however, the reliable pathological material is not very extensive, though it is every day accumulating, more particularly by the labours of Charcot and his followers in France, and Hughlings Jackson and others in this country. Up to a comparatively recent date physicians and physiologists generally held by the views of Flourens, based on experimental investigation of the brains of the lower classes of animals. According to Flourens the hemispheres were concerned purely with intelligence—a faculty one and indivisible; and each part of the hemisphere possessed the functions of the whole, so that, if part were destroyed, functional compensation might be effected by the parts which remained. These views seemed satisfactorily to explain the cases, not uncommon, in which, notwithstanding the existence of extensive lesions in the hemispheres, no symptoms were observed during life. The frequent association of aphasia with a limited lesion of the cortex cerebri, vaguely indicated by Bouillaud and Dax, and definitely fixed by Broca at the posterior extremity of the third left frontal convolution, was a step towards localisation of function in the brain, which, however, met with much opposition and counter-facts. The clinical and pathological observations of Hughlings Jackson in reference to the causation of limited and unilateral epileptiform convulsions were an important contribution to the physiology and pathology of the cortex. These convulsions he attributed to irritative or discharging lesions of the grey matter in the neighbourhood of the corpus striatum in the opposite hemisphere.

Physiological experiment has demonstrated the correctness of the views advanced by Hughlings Jackson, and shown that, not only can movements be excited by electrical irritation of certain regions of the cortex, but also that definite combinations of muscular movements uniformly result from stimulation of certain specialised areas within this region. The interpretation of these facts, now no longer disputed, has been much debated, but the views the writer has elsewhere expressed at length (*Functions of the Brain*) seem in accordance with the most recent and careful pathological and clinical research, viz. that the brain is divided into a motor and a sensory region, and that in each there are definite centres with definite functions, and that the symptoms of cortical lesions depend

on the locality of the lesion, and on whether it is unilateral or bilateral.

Physiological experiment is, as to precision in its results, considerably in advance of clinical observation, and, from the nature of the two methods, this is what might be expected.

The investigation of diseases of the brain is surrounded by special difficulties. Though, as shown by physiological experiment, the brain is capable of being mapped out into different regions possessing different functions, yet the brain acts as a whole, and it is not always easy to analyse the facts of disease, and to distinguish with certainty between the effects directly dependent on the locality of the brain and those due to the indirect influence exerted on the functions of neighbouring regions and on the brain as a whole. And when, moreover, we take into account the vague manner in which it has been the custom to define the locality of the lesion, it is not surprising that so little has as yet been accomplished in reference to the localisation of cerebral disease.

But, besides these difficulties there are others, of greater magnitude and less easy to overcome, inherent in the subject itself. For the brain, besides being concerned with certain functions which we can investigate objectively, viz. sensation and voluntary motion, is the organ of mental operations, and as the same parts have an objective and subjective function, it is obvious that cerebral diseases may manifest themselves mentally as well as bodily. These two sides of brain-function and their disordered manifestations have been in a great measure artificially separated for convenience in treatment, and the relation between the physiological and the psychological has not been duly recognised. And yet it is obvious that until psychological phenomena have been reduced in ultimate analysis to their anatomical and physiological substrata we can have no rational medical psychology, as distinguished from empiricism or mere speculation, available as a guide to the diagnosis and treatment of cerebral disease in its subjective or mental manifestations.

That the brain is diseased in insanity, functionally or organically, is a fact now universally admitted; but it is also true that the lesions which cause objective symptoms in the domain of motion and sensation need not cause mental derangement, and also that lesions which cause mental derangement need not manifest themselves in any discoverable disorders of sensation or motion. In fact, for purposes of ideation we have practically two brains; for, though motion and sensation will be paralysed on the opposite side by destruction of one hemisphere, yet intelligence and thought are possible through the hemisphere which remains.

Various forms of lesion have been found in the brains of the insane, such as morbid conditions as to vascularity, degeneration of the blood-vessels, degeneration of the nerve-cells, neuroglia, membranes, &c.; but no constant relation has as yet been established between any one form of degeneration and any one form of mental alienation, or between the latter and any localised lesion. Nor has it been clearly established whether the forms of degeneration found in the brains of the chronically insane are the result or the cause of the mental disorders. An exception, however, is to be made in favour of general paralysis of the insane, where there seems to be a definite connexion between the anatomical lesion and the symptoms manifested. In this disease we find as a constant, if not the only factor, a form of chronic encephalitis, affecting chiefly the cortical regions which physiological experiment has shown to be the motor zone of the hemispheres. This lesion is associated with progressive motor paralysis, varied with intercurrent epileptiform and apoplectiform seizures, and with mental symptoms characterised generally by exalted ideas and delusion as to wealth, power, and grandeur. The motor symptoms are readily accounted for by the locality and character of the cerebral lesion, but the relation between this and the mental symptoms is a subject which psychological analysis has yet to elucidate.

Another link between the physiological and psychological aspects of brain-function is furnished by aphasia, in which, with a definite anatomical lesion, there is a definite psychological defect (*see* APHASIA). But beyond these the relation between morbid mental manifestations and morbid conditions of the brain, and their joint relation to the bodily symptoms, remain involved in great obscurity.

The objective symptoms of cortical lesions depend on their locality, and on whether they exercise an irritative or destructive influence on the parts they invade. From the localisation point of view alone the intimate nature of the morbid process is unimportant, except in so far as its irritative or destructive character is concerned. Lesions, such as tumours, which from their very nature exercise important indirect effects on the encephalon as a whole, apart from their effects on the regions which they directly invade, can rarely be exactly localised, owing to the difficulty of separating the direct and indirect symptoms from each other and referring each to its exact cause. Also no rigid conclusions as regards localisation can be drawn from morbid affections of the hemispheres which extend over a large area, such as the various forms of meningitis and meningo-encephalitis. In all these cases the nature of the affection must be diagnosed from its own general and special characters; its position and extent in the brain being arrived at approximately from a consideration of the effects of accurately circumscribed lesions, as determined by careful clinical and pathological observation and physiological experiment.

The brain may be considered as divided into a *motor* and a *sensory* zone.

Motor Zone.—The motor zone includes the convolutions bounding the fissure of Rolando, viz. the ascending frontal and the bases of the three frontal convolutions, the ascending parietal and postero-parietal lobule, and the internal surface of the same convolutions or paracentral lobule. In this zone are differentiated centres for the movements of the limbs, head, and eyes, the muscles of expression, and those of the mouth and tongue. The centres of the leg and foot are situated in the postero-

parietal lobule, those for the arm in the upper third of the ascending frontal, those for the hand and wrist in the ascending parietal, those of the facial muscles in the middle third of the ascending frontal and base of the second frontal, those for the mouth and tongue at the lower third of the ascending frontal at the base of the third frontal, and for the platysma at the lower extremity of the ascending parietal, just posterior to the mouth-centre. The posterior third of the upper frontal convolution and corresponding part of the second frontal, contain the centre for the lateral movement of the head and eyes.

The frontal regions in advance of this centre, though anatomically related to the motor division of the internal capsule, do not seem directly connected with motor manifestations as judged by the negative effects either of irritation or extirpation.

Irritative lesions of the motor zone proper, such as may be induced by syphilitic lesions, tumours, spicula of bone, depressed fractures, thickening of the membranes, &c., cause convulsions, which may remain limited to one limb or one group of muscles without loss of consciousness, or affect the whole of the opposite side with loss of consciousness, or become more or less bilateral with all the symptoms usually observed in so-called idiopathic epilepsy.

If the convulsive phenomena begin always in the same way, and if they frequently remain localised in one limb or one group of muscles, and especially if paralytic symptoms manifest themselves, the exact position of the lesion in the opposite hemisphere may be accurately diagnosed. (*See* cases by Hughlings Jackson, *Clinical and Physiological Researches on the Nervous System* (reprints), 1873; Dr. Dreschfeld, *Lancet*, Feb. 24, 1877; Dr. Bramwell, *Brit. Med. Journ.*, Aug. 28, 1875; MM. Charcot and Pitres, *Revue Mensuelle*, 1877.)

Destructive lesions of the motor zone cause general or limited paralysis of voluntary motion in the opposite side of the body, according as the lesion affects the whole of the motor zone or is limited to special centres within this area. The causes of destructive lesions of the cortex may be various—hæmorrhage, laceration by wounds, &c. One of the most common causes is embolism or thrombosis of the arteries supplying the cortical motor area. These are derived from the Sylvian artery of the middle cerebral. The cortical branches may be occluded without interfering with the circulation in the corpus striatum, which is supplied by special branches, as shown by the researches of Duret and Heubner.

When the motor zone is affected by general destructive lesion, complete hemiplegia of the opposite side results, in all respects like that resulting from destructive lesion of the corpus striatum and anterior portion of the internal capsule. In this form of paralysis the loss of motion is most marked in those movements which are most independent, hence the arm is more paralysed than the leg or face, and the hand more paralysed than the shoulder movements of the arm. This has been accounted for by the fact, that the centres for bilateral movements are intimately associated in the lower ganglia; hence the stimulus from one hemisphere can to a certain extent call forth the action of

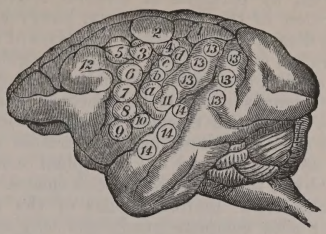

FIG. 12.—Side view of the Left Hemisphere of the Monkey. The areas have the same signification as in the next figure.

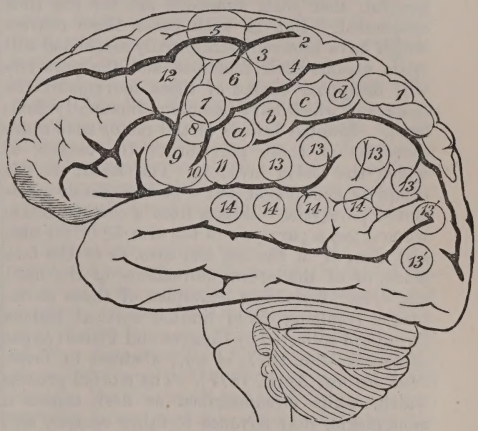

FIG. 13.—Side view of the Left Hemisphere in Man, with the areas of the cerebral convolutions. The effects of stimulation of each area, as ascertained by experiments on the brain of the monkey, are subjoined.

1. Postero-parietal lobule. Advance of the opposite hind limb, as in walking.

2, 3, and 4. Around the upper extremity of the fissure of Rolando. Complex movements of the opposite leg and arm, and of the trunk, as in swimming.

a, *b*, *c*, *d*. Ascending parietal convolution. Individual and combined movements of the fingers and wrist of the opposite hand. Prehensile movements.

5. Posterior extremity of the superior frontal convolution. Extension forward of the opposite arm and hand.

6. Upper part of ascending frontal convolution Supination and flexion of the opposite forearm.

7. Median portion of ascending frontal convolution. Retraction and elevation of the opposite angle of the mouth.

8. Lower part of the ascending frontal convolution. Elevation of *ala nasi* and upper lip, with depression of lower lip.

9 and 10. Inferior extremity of ascending frontal convolution (Broca's convolution). Opening of the mouth with (9) protrusion and (10) retraction of the tongue. Region of aphasia. Action bilateral.

11. Between the inferior extremities of the ascending frontal and the ascending parietal convolutions. Retraction of the opposite angle of the mouth; and the head turned slightly to one side.

12. Posterior portions of superior and middle frontal convolutions. Eyes opened widely; pupils dilated; head and eyes turned towards opposite side.

13 and 13′. Supra-marginal lobule, and angular gyrus. Eyes moved towards the opposite side, with an upward (13) or a downward (13′) deviation. The pupils generally contracted. (Centre of vision.)

14. Infra-marginal (superior temporo-sphenoidal) convolution. Pricking of opposite ear; head and eyes turned to opposite side; pupils largely dilated. (Centre of hearing.)

the conjoint motor nuclei. The electrical contractility and nutrition of the muscles is not effected by paralysis of cerebral origin. The nutrition of the muscles may, however, suffer from disuse, and frequently paralyses of cortical origin are followed after a time by rigidity and contraction, accompanied with descending secondary sclerosis of the motor tracts of the crura, pons, and lateral tracts of the spinal cord. In some cases the descending degeneration invades the anterior cornua of the spinal cord, and atrophy of the paralysed muscles ensues. Occasionally from limited lesions of the cortical motor area complete hemiplegia may occur on the opposite side for the time at least. This is to be explained by the fact that sudden establishment of a destructive lesion may cause such commotion or perturbation of the centres in general, that their functions are for the time suspended. But in such cases those centres which have been only functionally suspended will again resume their functions, and the paralysis will disappear except of those movements the centres of which have become permanently damaged. Limited lesions of the motor zone cause paralysis of those movements the centres of which the lesion invades. The result is not complete hemiplegia, but a *monoplegia* or *dissociated* paralysis. Hence, from a cortical lesion we may get a paralysis of the arm, or of the arm and face, or of the leg and arm, or of the face alone, or of the lateral movements of the head and eyes. Numerous examples of these monoplegiæ resulting from limited cortical lesions have been collected by Charcot and Pitres (*Revue Mensuelle*, Jan. 1877, *et seq.*; abstract in *Lond. Med. Record*, April, 1877). The morbid process which, while circumscribed at first, causes a monoplegia, may advance to other centres, and after a time produce general hemiplegia of the opposite side. Hemiplegia so resulting is a succession of monoplegiæ, and is a sure indication of cortical disease. It is to be noted that destructive lesion of the mouth-centre (Broca's region) on one side does not cause paralysis of articulation, owing to the fact that each centre has a more or less complete bilateral influence over the movements of the mouth and tongue. Destructive lesion of this centre in the left hemisphere generally gives rise to aphasia without paralysis of articulation (*see* APHASIA). In bilateral lesions there is both aphasia and paralysis of articulation (*see* Dr. Barlow's case, *Brit. Med. Jour.* 1877, vol. ii. p. 103). Limited cortical motor lesions are frequently associated with transitory rigidity of the opposite side of the body; and if the lesion is complete, the local paralysis or monoplegia will remain permanently, and may be accompanied by late rigidity and descending sclerosis of the motor tracts, as has been shown by Charcot (*op. cit.*). These monoplegiæ frequently alternate with unilateral convulsions, owing to the morbid process occasionally inducing irritation of the neighbouring centres.

Destructive lesions of the frontal and orbital regions cause no motor paralysis or any very evident physiological symptoms. In the recorded cases of bilateral lesions symptoms of dementia to a greater or less extent have been noted.

Sensory Zone.—From experiments on the brain of monkeys by means of the complemental methods of excitation by the electric current, and destruction of the grey matter of the cortex, the writer has arrived at the conclusion that in the regions lying posterior to the motor zone there are differentiated centres of sight, hearing, touch, smell, and taste. The sight-centre is situated in the angular gyrus, and embraces also the occipital lobe—the occipito-angular region; the centre of hearing is localised in the superior temporo-sphenoidal convolution; the tactile centre is situated in the hippocampal region; while the centres of smell and taste are situated together at the lower parts of the temporo-sphenoidal lobe.

Destructive Lesions.—Unilateral destruction of these sensory centres does not, however, appear to permanently abolish sensation on the opposite side of the body. It is only when the lesion is bilateral and in corresponding points that the loss of sensation is thorough and permanent. Hence the fact is to be accounted for, that in man, as a rule, unilateral destructive lesions of the regions indicated are latent, or not, so far as at present known, accompanied by any objective symptoms. Numerous cases of this kind are on record. No secondary descending degeneration of the spinal cord has been observed in these cases.

Until evidence is increased from human pathology of the occurrence of loss of sensation from lesion of the cortex—and this the writer holds is to be looked for in bilateral destructive lesions—pathologists in general reserve their opinion as to the explanation of the latency of the lesions in question.

But though the pathological evidence in favour of the localisation of distinct sensory centres is as yet comparatively slender, it is daily increasing. Though numerous cases are on record of lesions in the angular gyri and occipital lobes without symptoms as regards vision, there are others, more particularly of lesions of the medullary fibres of this region, in which hemiopia towards the side opposite the lesion has been observed. Some of these cases may perhaps be explained by direct or indirect lesion of the optic tract, but others cannot be so accounted for. For other facts bearing on this question the reader is referred to a paper by the writer on Cerebral Amblyopia and Hemiopia, *Brain*, xii. 1881.

It has been established by the researches of Türck, Charcot, &c., that destructive lesions of the posterior third of the internal capsule, external to the optic thalamus, cause hemianæsthesia of the opposite side of the body. The hemianæsthesia of organic origin exhibits the same symptoms as are observed in what is termed hysterical hemianæsthesia. In this condition there is loss of tactile sensation and more or less complete loss of sight, hearing, smell, and taste, on the side opposite the lesion. The affection of sight, which is not accompanied by any changes in the eye discoverable by the ophthalmoscope, is characterised by dyschromatopsy, and a remarkable contraction of the field of vision. The loss of hearing is very marked, if not absolute, and similarly as regards smell

and taste. It is evident that the lesion situated in the medullary fibres is not an affection of sensory centres, and that it is simply a solution of continuity of the centripetal paths which radiate out into the differentiated sensory centres of the cortex. The exact destination of the special sensory paths the writer has indicated above, and to this the special attention of physicians and pathologists should be directed. The writer is likewise of opinion that the loss of smell and taste, which is occasionally observed to result from a blow on the occiput or vertex is in many cases due to injury by counterstroke to the centres of smell and taste, which are situated in such a position as to be specially affected by violence so directed. There is no doubt that in some cases the loss of taste might be accounted for by rupture of the olfactory tracts or nerves, such as those in which taste is lost only for flavours, which are compounds of smell and taste. But there are others in which there has been clear loss both of smell and taste independently of each other; cases which can only be satisfactorily accounted for, in the writer's opinion, in the manner which he has indicated.

Irritative Lesions.—Though the pathological evidence in reference to the localisation of sensory centres is as yet but deficient, at least as regards paralysis of the special senses from destructive lesions of the cortex, there is good reason for believing that in cases of insanity, accompanied by sensory hallucinations, as also in certain cases of epilepsy ushered in by subjective sensations, such as flashes of light and colour, loud sounds, disagreeable tastes and smells, &c., the phenomena are the result of some morbid irritation of the cortical sensory centres, the anatomical substrata of ideation.

D. Ferrier.

CONVULSIONS.—Definition.—This term is commonly given to more or less general, purposeless muscular contractions, occurring simultaneously and successively for a variable time. It is also, however, applied at times to certain more localized purposeless contractions, though these would be more appropriately (and are in the majority of cases) termed Spasms. The latter, like Convulsions, are of two kinds, *tonic* and *clonic*.

Classifications.—Convulsions have been variously classified by different authors according to the different points of view from which they have been regarded. Looking to their causation, there is both a clinical and a physiological division into classes. From the former standpoint we have (1) primary or essential convulsions; (2) sympathetic convulsions; and (3) symptomatic convulsions; whilst from the physiological point of view they have been divided into (1) centric and (2) excentric. These classifications are arbitrary and will not stand the test of a critical examination, though the first of them is to a certain extent useful. Again, looking to the distribution of the convulsions, or to the parts involved, their classification by different writers may be summarized as follows:—(1) *External—a*, general; *b*, unilateral; *c*, partial; (2) *Internal*.

These various terms need little explanation, though something requires to be said in regard to them.

Convulsions are termed *primary* or *essential* when they occur either without assignable cause, from mental or moral perturbations, or as a result of some local irritation. They are called *sympathetic* when the convulsions declare themselves as a prelude to, or in the course of, any of the specific fevers, as a consequence of acute pulmonary or renal affections, or in association with disordered states or structural diseases of any of the organs of the body other than those of the nervous system; whilst the name *symptomatic* has been applied to the convulsions which occur as a result of injury or structural disease of the nervous system itself. The unilateral convulsions which affect one half of the body only, as well as other more partial convulsions, are almost entirely confined to this latter group, though general convulsions of the symptomatic type are perhaps just as frequently met with. The so-called *internal convulsions* constitute an ill-defined group, the members of which are scarcely worthy of the name of convulsions at all. They are rather tonic or clonic spasms of particular parts. The best known member of this group is laryngismus stridulus (*see* separate article thereon), though we may also include another much less grave, though often obstinate malady, viz. a spasmodic and frequently recurring hiccup. Some would include angina pectoris also in this group.

Convulsions, either tonic or clonic, or both, enter into or form the semeiological basis of five principal diseases having separate places in our nosology. These are *Eclampsia, Epilepsy, Tetanus, Hydrophobia*, and *Chorea*. All but the first of these diseases will be fully considered in their respective places, so that Eclampsia alone would remain. But Eclampsia and Convulsions are convertible terms, meaning almost absolutely the same thing. The former term, indeed, is useless except for the mere purpose of literary precision. In epilepsy and in eclampsia we have equally to do with convulsions, which are now admitted by almost all modern writers to be quite indistinguishable from one another. The former name, however, is given to convulsions which have a known tendency to recur at variable intervals; whilst the latter has been commonly applied to convulsions which are either solitary or, if not exactly so, which occur as a closely successive cluster or group, more or less distinctly sympathetic with some general or local bodily condition. Seeing that there is, in a very large number of cases, almost nothing in the nature of the attack itself to enable a medical man, called to a patient in convulsions for the first time, to say whether he has to do with an attack which will be repeated or not, it is easy to understand that eclampsia is a word more frequently to be seen in books than to be heard at the bedside. In books we may read of eclampsia neonatorum, the eclampsia of parturient women, and uræmic eclampsia; though the more common clinical equivalents are infantile convulsions, puerperal convulsions, and uræmic convulsions. The distinction between epilepsy and eclampsia is, therefore, one which is to a very great extent purely artificial.

Convulsions have a frequent though less constant relationship also with many other affec-

tions, such as general paralysis of the insane, tubercular meningitis, chronic hydrocephalus, hemiplegia, and hysteria.

Ætiology.—The causes of convulsions are oftentimes more than usually complex, constituting a web of causal conditions partly made up of (*a*) predisposing, partly (*b*) of exciting, and partly (*c*) of proximate elements. It is often the fashion to pick out some one of the most prominent or easily recognizable of these factors, and speak of it as 'the cause' of the attack. It must never be forgotten, however, that this so-called cause, in any given case, may be able to act as such only when in conjunction with certain other more obscure, though perhaps not less potent, co-operating conditions. Without the conjoint influence of the latter it might have been quite powerless to produce any such results. Hence the proverbial uncertainty in regard to the action of any of the more important factors, or so-called 'causes,' upon different individuals whose age, state of health, predisposition, or surrounding conditions are not similar.

The question of the causation of convulsions resolves itself, however, into two distinct departments, one of which is strictly clinical in character, whilst the other is more strictly physiological. It is one thing for the medical man to ascertain what are the particular individual states, conditions of life, and occurrences, physical or moral, which have contributed to induce an attack of convulsions (to ascertain which he studies the 'predisposing' and 'exciting' causes of the disease); but it is quite a different problem when he endeavours to unravel, by anatomico-physiological data, the actual mode of production of the convulsions. In this latter part of the inquiry he has to do with what are called 'proximate' causes, and is brought face to face with a problem still involved in great obscurity, and concerning which the most opposite views are held by leading pathologists and physiologists. This second part of the problem of causation, for the present, concerns us less than the more strictly clinical side of the inquiry, and it will be only incidentally referred to in the present article. It will be fully considered in the article Epilepsy.

Predisposing Causes.—The most important of these is the existence of an unduly excitable nervous system—one in which there is an exaltation of the tendency to produce reflex movements—an 'undue mobility of the nervous system,' as it is sometimes called. This is a state of things which is naturally more marked in women than in men, and is also notably prominent in young children of both sexes. It is, moreover, much exaggerated in some children of nervous habit, who, besides being unduly emotional or excitable, are very prone to start or tremble on the least noise, and are subject to muscular twitchings in various parts of the body. With increasing age, and more especially in the male sex, we find the sensorial and emotional nerve-centres becoming less excitable, owing, in great part at least, to their more complete subordination to the controlling or inhibitive influence of the developing cerebral hemispheres.

The predisposing groundwork being of this nature, how is it caused, or to be accounted for? (1) It may be inherited from one or both parents, or from grandparents, who may themselves have possessed a nervous system of this type, and may, morever, have been subject to fits or other well-marked disease of the nervous system. But though not inherited in the strict sense of the term it may (2) be connate; the patient may always (*i.e.* from birth) have possessed a nervous system of this type, as an accompaniment of the mere low vitality which is often seen in children born from parents who are simply weak and debilitated, or in those whose parents have been advanced in life. (3) At other times the nervous system may have acquired such predisposing characters some time during the life of the individual (especially during childhood or adolescence) owing to the action of various sets of conditions, some of the best established of which are these:—(*a*) The cachexia sometimes following measles, pertussis, &c.; (*b*) insufficient or improper food; (*c*) chronic diarrhœa; (*d*) hæmorrhages or exhausting discharges.

If we turn now to the various *exciting causes* we find these so powerfully influenced by the age of the patient, as to make it desirable to consider them in reference to different periods of life, which we may artificially though conveniently mark off from one another.

Infancy (from birth to end of 2nd year).—In certain cases convulsive attacks are congenital; and here perhaps the most frequent exciting cause is a meningeal effusion of blood which presses upon and irritates the surface of the brain—the extravasation having in some cases been occasioned during parturition where it has been prolonged or unnatural. These congenital attacks are most frequently associated either with more or less marked hemiplegia, or with a subsequent partial or distinct condition of amentia or idiotcy. Such unfortunate infants may continue quite unable to stand or even sit up; they remain unable to speak, and, as in a case which I have recently seen, the child may be quite blind. Meningeal or superficial hæmorrhages may also occur in young infants, under the strain of the mechanical congestion produced by violent fits of coughing in pertussis or bronchitis, and in some of these cases such effusion may be followed by convulsions. Fits in infancy may also follow falls or blows upon the head, though at this early age such occurrences are comparatively rare.

In infancy, again, convulsions may usher in or subsequently supervene in almost any acute disease, this being especially the case with measles, scarlet fever, and other of the exanthemata; in pneumonia or bronchitis; and also in tubercular meningitis.

But, still more frequently, convulsions in infancy are excited by mere peripheral irritations, as during the process of teething, from an overloaded stomach, or from indigestible food. Diarrhœa, worms, &c., also take their place as more or less frequent excitants of convulsive paroxysms in infants—though worms only begin to appear towards the end of this period. But though irritations in the field of distribution of the 5th and pneumogastric nerves are especially potent in exciting convulsions, irritations of other parts of the body may also lead to similar results. whether they are occasioned by the injudicious disposition of pins, by tight strings wounding or

irritating the skin of the body, or by any other means. The more distinctly predisposing conditions exist, the more frequently will any or all of these exciting causes give rise to an attack of convulsions.

Lastly, an infant which has taken the breast of a woman who has shortly before been much perturbed by violent anger, grief, or any other strong emotion, may thereafter, if predisposed, be seized with convulsions—probably owing to the milk of the nurse having been so altered in quality as to have led to gastric trouble and irritation in the infant.

Childhood (from the 2nd to the 13th year).—Most of those exciting causes which are influential during the last period continue to be occasionally operative in this—especially during the first half of it. Meningeal hæmorrhages are now rarer, though they may still occur during violent paroxysms of coughing, and also from falls or blows upon the head. The latter causes of hæmorrhage may, however, act in producing fits in other ways, *e.g.* by concussion, shock, &c., and they now come to be more frequently operative. The exanthemata are still apt to be preceded or associated with convulsive attacks; and irritations, especially from teething or irritants (undigested food or worms) in the intestinal canal, are also still apt to be followed by such a sequence.

During this period another cause of considerable potency comes into operation with great frequency, and this is fright. The first fit either follows the fright more or less immediately, or it may not take place for days—perhaps for weeks—after the sudden emotional disturbance. During the interval, however, the health and mental condition of the child is generally obviously disturbed. Proper treatment at this stage may prevent the occurrence of fits. Scrofulous tumours in the brain sometimes help to determine convulsions in children.

Adolescence (from the 13th to the 20th year).—Fright or other sudden emotions, falls upon or blows about the head, still appear as frequent excitors of convulsive attacks which recur (epilepsy) at this period of life, though meningeal hæmorrhages, acute diseases, and peripheral irritations are much less frequently operative than at earlier periods, since the special irritability of the nervous system characteristic of childhood decidedly abates as the cerebral hemispheres develop and begin to exercise a more powerfully controlling influence over the lower centres.

Other and new causes, however, come into play at this epoch. The establishment of puberty is a kind of crisis during which, independently of all other causes, convulsions or fits may be initiated in those whose nervous systems are at all predisposed towards such an occurrence. This is more especially so in the case of the female, partly because of the existence of a more frequent predisposition in persons of this sex, and partly because of extra excitations in association with the establishment of the catamenia—whether this be brought about imperfectly or in a natural manner. Ovarian or uterine irritation, or irregularity of the functions of these organs at any part of this period, may help to occasion fits which may or may not take an hysterical type. Masturbation may also be added as an occasional provocative of epilepsy at this critical period of life, though I am inclined to think too much stress is often laid upon this as a cause. When operative this mode of causation occurs more frequently with the male than with the female sex.

Excessive study and mental application, as well as worry or anxiety, must also undoubtedly be enumerated amongst the causes of epilepsy at this period of life.

Neither must we forget the possible existence of aneurysms of the arteries or of morbid growths in connection with some portion of the brain or its meninges, either of which may act as occasional excitants of epileptic paroxysms. This cause also figures in earlier periods of life—more especially in those of a scrofulous type. And in some of such cases the new-growth may lead to the supervention of chronic hydrocephalus, and thus render the occurrence of convulsions even still more likely.

Early Adult Age (20–40 years)—Fits originate much less frequently during this period of life than in adolescence or childhood. They are, however, apt to supervene more especially when the general health is lowered under the influence of various exciting causes. Grief and mental worry, more especially when combined with long-continued bad sleep, and the labours or cares of business, are then apt to induce them.

Blows or falls upon the head may still be followed by attacks of this kind, though perhaps with less frequency than in the earlier periods of life.

Syphilitic indurations or growths from the meninges may now occur; and other attacks (often of one-sided convulsion) may be determined by various pathological changes or accidents taking place in regions of the brain where more severe lesions would give rise to hemiplegia. The primary change in these cases may be minute hæmorrhages into the brain-substance, or minute and slight softenings produced by stopping of small vessels (embolism or thrombosis). From lesions of this kind hemiplegia and epilepsy are often more or less associated. Occasionally the cause may be a non-syphilitic tumour, occupying the side or base of the brain.

Puerperal convulsions in the female, and uræmic convulsions in both sexes, are most frequently met with during this period of life. During pregnancy the reflex excitability of the nervous system is often greatly increased, and in the production of puerperal convulsions some amount of uræmia also intervenes not unfrequently. Intemperate habits, carried to excess, frequently produce fits, and so also may venereal excesses.

After Middle Age (40 years and onwards).—The mobility of the nervous system gradually diminishes during this period, so that epileptic attacks commence now with still less frequency. There is, however, one period (the climacteric) in the female sex in which this mobility is temporarily increased, and in which fits again become more frequent, under the influence of apparently slight exciting causes.

Although fits are only very rarely liable to be induced by the sequelæ of hæmorrhages or of softenings of the brain, yet these events now

grow more common as age advances, and are therefore to an almost corresponding extent more liable to figure as causes of epileptic attacks. An attack of hæmorrhage or of softening may be ushered in by epileptiform convulsions (especially when the lesion occurs in certain parts of the brain), and in some cases such attacks may thereafter recur at irregular intervals. Exposure to great heat, or sunstroke, may also at this period, or earlier in life, act as the exciting cause of convulsions.

Mental overwork, worry, fright, and such-like influences, are much less likely to operate in persons over 40 than in earlier life; and the same is to be said of blows or injuries of the head, short of the most severe causing actual lesions of the brain. But the malnutrition and degeneration induced by intemperate habits may predispose to symptoms of this kind; and so also may blood-poisoning from renal disease, which is now not unfrequently present.

Various organic diseases of the brain, whether principally characterized by degenerations with a process of more or less general atrophy, or with localized overgrowth of connective tissue, are also not unfrequently productive of convulsions, either in persons of middle or of advanced age. A well-marked instance of the former of these associations is to be met with in general paralysis of the insane. Cysticerci on the surface of the brain have also in some recorded instances been the cause of most obstinately recurring convulsions.

Lastly, it should always be borne in mind that convulsions are sometimes the result of the action of poisons of various kinds upon persons of any age. Occasionally such poisoning may be brought about by articles of diet, such as mussels or fish in certain states, or from poisonous mushrooms; whilst at other times it results from some of the well-known narcotico-irritant poisons, taken either inadvertently or purposely.

Anatomical Characters.—These may be said, so far as our present knowledge goes, to be absent. It is true that general or partial congestion of the brain may frequently be encountered in those who die during an attack of convulsions. But this congestion is to be regarded as a result rather than as a cause of the fit. The convulsions are due to mere molecular changes in the brain, inappreciable to, or at all events unappreciated as yet by, the most skilled microscopists. When fits occur in association with actual organic growths or other lesions of the cerebral cortex or elsewhere, such lesions may form merely the starting points for nervous impressions which travel downwards so as to upset the equilibrium of certain unstable or highly charged motor centres; just as a similar disturbance of nervous equilibrium with discharge of motor energy may result in another case from abnormal visceral impressions (induced it may be by indigestible matters in the intestine or by an acute disease of the lungs), or from some surface-irritation. In accordance with this point of view, such organic growths or other lesions need receive no further mention here. Those who may be inclined to think otherwise, should bear in mind the fact that convulsive attacks are easy to be produced in animals from whom the cerebral hemispheres have been removed.

Symptoms.—The varied nature of the causes make it impossible to say anything of moderate compass concerning the premonitory signs or symptoms which may precede an outbreak of convulsions. These must necessarily vary immensely in different cases. Some of the characters of the predisposing state have been already alluded to (p. 300). The onset is, however, often abrupt and without any distinct premonitory symptoms.

With regard to the actual characters of the attack it will be sufficient to say here that they also vary immensely in different cases; and as notwithstanding this great variability it is impossible in any individual case to tell, from the nature of a first convulsive fit, whether it will form a more or less isolated attack, or whether it will constitute one of a subsequently recurring series, the reader may, for this part of the subject, be referred to the description of the attacks given under Epilepsy. All that is there said concerning the actual phenomena and mechanism of the attack, holds good for occasional convulsions as well as for those which are habitual. In each we have to do with (1) a more or less distinct stage of tonic spasms, followed (2) by one of clonic spasms, and (3) succeeded by a state of stupor. One or other of such stages is, however, not unfrequently more or less abortive. These attacks may, at times, so rapidly follow one another as to be merged into one long series or *status convulsivus*, differing in no respect from the analogous *status epilepticus*.

Complications and Sequelæ.—The complications are most various, seeing that in different cases we may have to do with irritated gums, repletion, diarrhœa, worms, or an acute specific disease; whilst in other cases it may be with general debility and sleeplessness, with mental anxiety, puberty, or the climacteric period. Again pneumonia, renal disease, pregnancy, ovaritis, or some organic brain-disease may be the accompanying condition.

The nature of the sequelæ will depend principally upon the frequency of the attacks and the duration of the period during which the patient has been subject to the recurrence of them, so that for this part of the subject the reader may refer to the article Epilepsy.

Diagnosis.—There is very little difficulty in regard to the diagnosis of the affection. The differential characters of Laryngismus Stridulus are given elsewhere, and the absence of any real distinction between a fit of Eclampsia and a fit of Epilepsy has already been insisted upon. Neither of these affections can be easily confounded with certain forms of Chorea, which occasionally present themselves in adults, with movements not unlike those of ordinary convulsions. The more continuous nature of the movements, and the fact that consciousness is not impaired, suffices to distinguish all forms of Chorea. The spasms of Tetanus and Hydrophobia are also easily distinguishable from an ordinary attack of convulsions.

The characteristics of hysterical convulsions will be pointed out in the article on Hysteria.

The real difficulties from this point of view

of diagnosis have reference to the cause of the attack. To arrive at a decision in regard to this is often very difficult and occasionally impossible, at all events when a patient first comes under observation. At other times, however, the indications are so plain that there can be little or no difficulty. It is a question which should always be considered with the utmost care, since on the correctness of our conclusions in regard to this point the efficacy of the particular line of treatment which we adopt must necessarily depend. Nothing is more to be deprecated than hasty jumping at conclusions, from mere routine and superficial considerations. The condition of the patient must be carefully examined, and the nurse, attendants, or relatives must be closely questioned in order that we may learn as much as possible as to the previous state of health of the patient, and more especially as to the time and events which immediately preceded the first outbreak of an attack of convulsions. Examination and enquiries combined may convince us that the convulsions are (1) of the primary or idiopathic variety, immediately occasioned perhaps by fright, anxiety, overwork, overmuch or indigestible food, &c.; or we may come to the conclusion that the convulsions are (2) of the sympathetic order dependent upon pregnancy, renal disease, the onset of an acute specific fever or of pneumonia, or due to the existence of hooping cough, scarlet fever, &c. Or, in the absence of reasons for placing them in either of these categories, we may be forced to conclude that they are (3) symptomatic of some organic brain-disease, the nature of which must then be determined as nearly as possible, judging from the age of the patient, the mode of onset, his present state and associated conditions.

In any case we may have to enquire more closely as to hereditary tendencies, or acquired predisposing causes, which sometimes reduce the nervous system to such a degree of irritability as to lead to an attack of convulsions without the aid of any obvious exciting cause. In infants or very young children such a condition of the nervous system may display itself by great restlessness and startings at night, by the child's sleeping with half-open eyes, by drawing in of the thumbs across the palms, by twitchings of the limbs, of the angles of the mouth, or of the facial muscles generally. In older children and in young adults the signs which most easily mark a similar below-par condition of the nervous system are twitchings of the muscles about the angle of the mouth and of the tongue (the former being especially well seen when the latter organ is tremulously protruded for inspection) associated with debility, anorexia, partial insomnia, and general nervousness. In nervous girls fits are induced by very slight causes about the time when the catamenia become first established. The indications for treatment must in fact vary immensely in any five consecutive cases of convulsions to which the practitioner may be summoned.

Prognosis.—The possibilities under this head are at least six in number in regard to any case of convulsions:—(1) The patient may recover after having a single fit or a batch of them within a few hours or days, and may never have another attack. (2) The patient may recover, and though he or she may not have fits habitually thereafter, they may recur at prolonged intervals, when predisposing circumstances chance to be strong or are supplemented by an exciting cause of unusual potency. Thus convulsions during teething may cease, and may not recur till the constitution has been lowered by some illness years after, or when the nervous system has been rendered more irritable, as at the time when the catamenia are about to commence, especially if some slight fright should also come into operation as an exciting cause. (3) The patient may recover, though he subsequently continues to have fits either at irregular or regular intervals; he becomes, in short, a confirmed epileptic. (4) The convulsions may come to be followed by temporary delirium or a more or less marked maniacal condition, recurring after all or some seizures. (5) The patient may recover from the convulsive attack and may or may not have another fit, though he may remain hemiplegic. (6) The patient may die during the attack or almost immediately afterwards, (*a*) from the effects of it, or (*b*) by reason of some organic lesion by which the fit itself has been determined.

Recoveries are fortunately common, but death, especially in infants, is by no means uncommon. We possess no accurate data to enable us to assign the numerical proportion of these terminations to one another and to the other above-mentioned sequences.

Treatment.—During the convulsion itself, whether we have to do with an infant or an adult, we must see that all clothes are thoroughly loose about the neck and chest, and the patient should be placed in the supine position with the head slightly raised. Beyond seeing that the patient does not knock or injure himself, owing to the violence of his movements, these should not be much restrained; although efforts should always be made to prevent the tongue being bitten, by slipping the most suitable thing at hand between the molar teeth on one side, when the age of the patient or the character of the fit renders it likely that this event might otherwise occur. Beyond such simple measures as this, the less we do during the actual continuance of the fit the better it will probably be for the patient. We know of no rational or successful means of cutting short an ordinary attack of convulsions, and in the face of such an attack we should be cautious lest evil might be done.

Where we have to do with a succession of attacks quickly following one another, and which have already lasted some time, the careful administration of chloroform may be tried, as it is very serviceable in many cases when a *status convulsivus* occurs in children or in adults—though it would not be desirable to have recourse to it in infants. Under similar circumstances, for the latter the warm bath may be substituted, and sometimes seems to do good. On the cessation of the convulsions, or during the intervals, the treatment to be adopted to prevent their recurrence must necessarily vary immensely according to the age of the patient, and according to the predisposing and exciting causes which appear to have been operative in inducing the attack.

An overloaded stomach will call for the speedy administration of an emetic, and where indigestible food has already passed into the intestine an enema or brisk purgative should be given. Diarrhœa must be checked, or anthelmintics administered when worms are suspected. Gums may be lanced if they seem really to need it. In many of these cases an acquired or hereditary predisposition will have to be combated by the careful regulation of the diet, so that nutritious and easily digested food are given in place of their opposites, whilst at the same time the most suitable nervine tonics and antispasmodics are administered. For general usefulness in such cases no remedies can compare with the bromides of potassium and ammonium. As part of the specific influence which they exercise over nerve-tissue, they fortunately establish a tendency to quieter and sounder sleep, of which such patients often stand much in need. Ten-grain doses three times a day should be given at the commencement to youths or adults, and afterwards increased if necessary. Or a larger dose may be given once a day, either in the morning or at night, according to the indications in each case. Quinine or belladonna may be often given simultaneously with great advantage. To young children or infants, the dose of the bromide must, of course, vary with their age. Valerianate of zinc and oxide of zinc are remedies of less power, though these and other drugs may be tried where bromides appear to fail. This general treatment is applicable to a large proportion of cases also in which in debilitated or 'nervous' patients fits have been brought on by fright, worry, or anxiety, or by no assignable cause. Fatigue of mind and body is always to be avoided, and in those instances in which over-attention to business or over-study have been in part operative in bringing on the fits, absolute rest must form an essential part of the treatment. In girls or young women in whom fits occur at the time of the establishment of the catamenia, or where they recur in association with an irregular menstrual function, the general health often requires our most careful attention.

The convulsions which belong to the class known as *sympathetic* have to be carefully considered in relation to the malady of which they are the forerunners or associates. When convulsions precede an attack of scarlet fever or of small-pox they usually subside of themselves as the disease develops. They are, however, of much more significance when occurring during the course or towards the close of one of these maladies or during an attack of hooping cough or of croup. Our indications for treatment must then be derived in the main from the general state of the patient, and this is also eminently the case where we have to do with uræmic convulsions.

The treatment of *symptomatic* convulsions, dependent upon actual organic brain-disease, must also necessarily be subordinated to that appropriate for the affection itself upon which such symptoms depend. No drug will be found more generally useful, however, than bromide of potassum in ten to fifteen-grain doses for an adult (administered three times a day), in checking or diminishing the repetition of convulsions in these cases. Sometimes the action of the bromide seems to be favoured by combining it with moderate doses of digitalis, especially in those cases in which there is great general nervousness in association with a disordered cardiac rhythm. Where sounder sleep is urgently necessary, chloral, either alone or in combination with bromide of potassium, should be given at bed-time. Tinctures of sumbul or of henbane are also at times useful adjuvants. Where we have to do with tumours of the brain, and especially with syphilitic growths in the meninges, much better results are to be hoped for from large and increasing doses of iodide of potassium, either alone or in combination with small doses of bichloride of mercury, with the administration of nutritious food and attention to the improvement of the general health. *See* BRAIN; and SPINAL CORD, Diseases of. H. CHARLTON BASTIAN.

CO-ORDINATION.—This term is used in reference to muscular movements principally. Certain parts of the nervous system have more especially to do with the calling into activity, and therefore with combining, the contractions of different muscles, both simultaneously and in succession, in the precise order in which they occur in the several motor acts of which we are capable. The nervous arrangements upon which these actions depend have come into being, both in the race and in the individual, by processes of organic growth and development *pari passu* with the possibility of executing these several movements. It would be wrong to expect, therefore, that an isolated organ should exist solely for co-ordinating muscular movements. The execution of the most habitual of these must depend, to a large extent, upon the activity of the ordinary motor tracts of the spinal cord and brain. The extent or precise mode in which the cerebellum intervenes in certain higher forms of co-ordination is still involved in much obscurity. That it has some share in such functions may be regarded as certain, though it probably intervenes far less than some would have us believe, who regard the cerebellum as *the* organ for the co-ordination of muscular movements.

Many nervous affections exist in which the co-ordination of muscular movements is more or less impaired. One of the most familiar of these is locomotor ataxy, a disease dependent upon a morbid process in the posterior columns of the cord. Sclerosis of the antero-lateral columns of the cord also not unfrequently disturbs the execution of muscular movements, especially those of the upper extremities. Chorea gives rise to very similar uncertainties in the execution of muscular acts. Spasms of all kinds, in short, tend to interfere with the harmony of the muscular movements in the course of which they intervene. Stammering is an affection of this kind, implicating the muscles of articulation, and certain disturbed cardiac actions characterised by disordered rhythm can only be regarded as belonging to the same category.

The above-mentioned are common instances of impaired co-ordination of muscular movements dependent upon structural or functional changes in parts of the nervous system other than the cerebellum. Certain diseases of this

organ, however, are known to give rise to a distinct form of inco-ordination. It is characterised by a reeling, unsteady gait in walking, with legs straggling, and mostly wide apart, to which the term 'titubation' is commonly applied. Other kinds of inco-ordination may hereafter be proved to depend upon diseases of the cerebellum. These are still very imperfectly recognised, and this is especially true in regard to its merely functional perturbations.

Certain inco-ordinations in speech and writing are common. Instances are to be found in that use of wrong words or misapplication of terms which we meet with in aphasic and amnesic persons; also in the substitution of wrong words in the act of writing, or of wrong letters in the writing of words, when such substitution is mechanical and unintentional—when it is wholly distinct, therefore, from mere inability to spell. These defects are inco-ordinations of a complex kind, dependent upon the perverted action of higher cerebral centres, in the same way that incoherent speech generally is dependent upon incoherent thought. There is reason to believe, indeed, that the same kind of ultimate defective nervous action which leads to inco-ordinations of movements when certain motor regions of the nervous system are affected, may, on the other hand, give rise to perverted perceptions (*illusions*) or to perverted thought (*incoherence*) when the disturbed nervous action occurs in other and in higher parts of the central nervous system.

H. Charlton Bastian.

COPHOSIS (κωφὸς, deaf).—Deafness. *See* Hearing, Disorders of.

COPPER, Poisoning by.—*Metallic copper* may be regarded as innocuous when swallowed, and the recent researches of Hirt show that those who are engaged in the metallurgy and manufacture of copper utensils are not specially liable to any diseases which can be attributed to copper as such. It is, indeed, stated that workers in copper enjoy an immunity from cholera, a conclusion which is based on very insufficient premisses. It is contradicted by the occurrence of cholera among coppersmiths in Buscau in 1866, and by certain other cases of a like nature reported by Hirt. That the disease is seldom found among workers in copper is true, but that the copper has anything to do with this result is not proved.

Though pure copper may be regarded as innocuous, it is otherwise with *alloys of copper*, more particularly with the alloys of copper with zinc and tin, known under the names of brass and bronze respectively, and with compounds of copper with lead or arsenic. In these the injurious agent would appear to be the alloy, and not the copper itself. An affection of a febrile character, and known as 'brass-founder's ague,' occasionally occurs on fusing days, and is attributable to the zinc fumes which are generated by the melting process.

The *salts of copper*, on the other hand, are capable of causing injurious and fatal results. The more important salts, from a medico-legal point of view, are the sulphate, blue vitriol, or bluestone; the acetates (basic and neutral) constituting artificial verdigris; and the carbonate or natural verdigris. The manufacture of verdigris is carried on to a large extent in the south of France. Plates of copper are acted on by the skins of grapes which are allowed to undergo the acetous fermentation. Those engaged in this industry on the whole enjoy good health, and it is only rarely that symptoms can be directly traced to the work; and then only when through sheer carelessness and uncleanliness quantities of the salt have been ingested. It is even said that dogs eat the refuse grape-skins without appearing to suffer from poisonous symptoms.

1. **Acute poisoning by copper.**—Symptoms.—The salts of copper, when taken in sufficient quantity, cause symptoms of acute poisoning, frequently terminating fatally. Twelve to fifteen grains of the acetate have been sufficient to kill a dog within an hour. The fatal dose in man is not quite determined; but doses above the usual emetic dose of the sulphate (ten to fifteen grains) have caused serious symptoms, and death has resulted within four hours after swallowing some pieces of the sulphate. Half an ounce would probably cause a fatal result. The symptoms are essentially those of irritant poisoning, viz., styptic or coppery taste, constriction of the fauces, epigastric pain, violent vomiting and purging, followed by collapse and death, usually with tetanic or convulsive symptoms. That which characterises copper-poisoning more especially, as compared with other irritants, is the frequent occurrence of jaundice. In dogs copper usually causes death with symptoms of paralysis of the hinder extremities, in addition to the usual irritant symptoms. It is said also to have a paralysing action on the heart.

2. **Chronic poisoning by copper.**— It is generally stated that the long-continued introduction of copper into the system in small doses gives rise to a form of chronic poisoning known under the name of 'copper colic.'

Symptoms.—The symptoms are essentially those of gastro-intestinal irritation, with nausea or sickness and diarrhœa. They have none of the characters of colic in the sense in which the term is usually employed. The hair and the cutaneous secretions of workers in copper and brass are sometimes found of a green colour, and a line is sometimes found at the margin of the gums and teeth, variously described by authors,—Corrigan calling it purple, while Clapton calls it green.

Though symptoms of gastro-intestinal irritation, as above described, have been found among workers in copper, the question is whether they are in reality due to the copper, or merely symptoms of a not uncommon affection showing themselves among copper-workers. That copper does gain access into the system, and may be detected in the urine during life, and found in the bones after death, without the individual showing any manifest symptoms during life, seems pretty well established. But though we may regard it as certain that symptoms of copper-poisoning are more rarely found than those of lead-poisoning among those who have to deal with these metals, yet it would be a very unwarrantable conclusion, and contrary to all that we know of the action of poisons, to assert that a substance which is undoubtedly poisonous can be taken freely into the system with impunity.

This is a point of considerable interest in reference to the accidental or wilful adulteration of articles of food with copper salts. Many cases are on record of severe symptoms resulting from the use of copper utensils in cooking, or more frequently from the storage of water or articles of food in copper vessels, especially if the food contains oil—which, on turning rancid, dissolves the copper—or vegetable acids, or even large quantities of ordinary salt.

Copper salts are also employed intentionally to impart a green, fresh colour to pickles and preserved vegetables, such as peas. It is asserted that the quantity of copper necessary to produce this effect is infinitesimal, and that no poisonous effects can be proved to have resulted even from long-continued employment of these vegetables as articles of food. This is strongly maintained by M. Galippe, who has tried them on himself and family. Assuming the impossibility of proving the injurious effects of copper-tinted vegetables, the question comes to be principally a social and economic one, as to the propriety or legality of adulteration of food at all, and especially with a substance undoubtedly poisonous. Copper is said by some to be a natural constituent of the human body, but Boutigny furnishes strong grounds for attributing the minute quantity which may be found in the liver to accidental introduction into the system from cooking utensils, or from fruits raised on manure containing copper.

Diagnosis.—The greenish or bluish colour of the vomited matters, which turn bright blue on the addition of ammonia, renders the diagnosis comparatively easy.

Treatment.—In *acute* cases the stomach should be evacuated by encouraging vomiting, or by the stomach-pump. Albumen in some form, as milk or white-of-egg, should be given in order to precipitate the copper. Iron filings may be given for a similar purpose.

In *chronic* poisoning the cause should be discovered and removed, or the individual removed from the cause. D. Ferrier.

CORN.—Synon.: *clavus*; Fr. *Clou, cor*; Ger. *Leichdorn, die Hühnerauge.*

A corn is a thickening of the epidermis, caused by undue pressure and friction, as by boots, shoes, or implements of occupation. It is usually situated on a prominence, such as that of a joint, where the skin is subjected to double pressure, and is therefore unable to yield, or between the toes. Corns are most common on the feet.

A corn usually begins as a general and uniform thickening of the epidermis, which is termed a *callosity*, (*tyloma, tylosis, Schwielen*). Callosities may occur on any part of the integument. Thus they may occupy the prominence of a joint, or spread over the heel or the metatarsal cushion of the foot from pressure in walking, or occupy the metacarpal prominences of the hand as in boatmen.

The callosity is composed of laminated epidermis; is thickest in the centre, becoming thin towards the circumference; and is more or less hard and condensed, smooth and hornlike in appearance, and yellowish in colour. When the irritation which gives rise to a callosity is prolonged, effusion is apt to take place beneath it, and it is raised like a blister, the effused fluid being sometimes serous and sometimes seropurulent. Whenever this happens, the subsequent separation of the horny layer results in spontaneous cure.

When the pressure giving rise to a callosity, instead of being diffused, is concentrated on a central point, the epidermis corresponding with that point increases in thickness, by its under surface, and forms a conical prominence; further pressure increases the length and breadth of the cone, and in this way a corn is established. Continued irritation enlarges the corn by hyperplasia of epidermic cells, and its pressure produces absorption of the derma, sometimes extending to the bone itself. Not unfrequently effusions of serum or blood take place beneath the conical prominence, and, in rare instances, a bursa is found between the corium and the joint.

At a late stage of its growth the corn has the appearance of a central core—technically, *the eye of the corn*—surrounded by a collar of smooth epidermis in the state of callosity. The core is a lamellated ovoid mass, corresponding in external figure with the cup by which it is produced; and consisting in substance of vertical cup-shaped lamellæ closely packed one within the other. In an old corn the shape of the entire core is conical, the point resting on the sensitive skin, and the signification of the term *clou* or nail applied to it by the French is made manifest. The substance of the corn resembles horn both in colour and density, but between the toes, where moisture is generally present, it remains white and soft, like soddened cuticle, and is thence named *soft-corn*. Effusion at its base is more common in the soft than in the hard corn.

Treatment.—The treatment of a corn is to remove its cause, namely, pressure and friction; but when this is impracticable, to equalize pressure, by which the corn will revert to the state of callosity. The second indication is best effected by some simple unirritating application, such as soap- or lead-plaster spread on washleather. As a preliminary to this application, as much of the hard epidermis as possible should be removed by soaking and scraping, and the core turned out with a blunt-pointed instrument. The soft corn may be removed as the hard one, or by snipping with scissors. When there is much pain and inflammation about the corn it should be treated by means of water-dressing. Chronic corns and callosities are much benefited by painting with iodine liniment, and the use of an unirritating protective plaster.

Erasmus Wilson.

CORNEITIS.—Inflammation of the cornea. *See* Eye and its Appendages, Diseases of.

CORNUA (*cornu*, a horn).—A synonym for horns. *See* Horns.

CORONARY ARTERIES, Diseases of. The diseases of the coronary arteries may be classified as follows: (*a*) atheroma and calcification; (*b*) aneurism; (*c*) occlusion of the orifice; (*d*) thrombosis; and (*e*) syphilitic disease.

a. **Atheroma and calcification of the coronary arteries** are ordinary, but by no means con-

stant sequelæ of similar changes in the root of the aorta. The disease may be general, affecting both vessels equally or unequally; or it may be limited to one of them, or even to a primary branch of either; and may lead to fatty degeneration or fibroid change of the corresponding substance of the heart. The experiments of Mr. Erichsen and M. Schiff have proved that the nutrition of the heart in health depends upon a free coronary circulation, and pathology has confirmed this conclusion. Dr. Quain found the coronary arteries diseased or obstructed in 13 out of 33 cases of fatty degeneration of the heart, and in one of these cases, the trunks of both vessels being healthy, a calcified coronary branch led to the only portion of the heart exhibiting fatty change. Of 55 cases of fatty degeneration of the heart collated by the author from the *Transactions* of the London Pathological Society, 21 exhibited atheromatous or calcific change of the coronary arteries. In 10 of these death occurred by rupture of the left ventricle, in 1 by rupture of the right ventricle, and in 2 by rupture of the septum ventriculorum, the coronary branch leading to the seat of rupture having been, in every instance, in a more advanced state of disease than the other portions of the vessel. From the foregoing statistics it would appear, that whilst fatty degeneration of the heart may exist independently of disease of the coronary arteries, the latter condition may be regarded as the *immediate* cause of fatty change in the heart, in the proportion of about 38 per cent. of all cases.

Symptoms and Signs.—There are none which are peculiar to this disease; those which exist being due to the consecutive changes in the substance of the heart. The doctrine formerly held, that calcification of the coronary arteries was the cause of angina pectoris, is no longer tenable. In an example of this disease in its most typical form, eventuating in death, which recently came under the writer's notice, the coronary arteries were found, on examination, to be perfectly sound.

b. **Aneurism** of the coronary arteries is of rare occurrence. It is usually preceded by atheromatous or calcific changes in the coats of the vessels, and may, therefore, be regarded as a disease of middle or advanced age. Dr. Gee has, however, published an example of coronary aneurism in which the patient was a boy of only seven years.

Symptoms and Signs.—There is no positive indication of coronary aneurism during life. When the termination is fatal, as it usually is, death occurs by hæmorrhage into the pericardium from rupture of the sac.

c. **Occlusion** of the orifices of the coronary arteries has been met with only in connection with calcific changes in the root of the aorta, a partially detached calcareous plate overlying the orifice of either vessel (both are rarely affected), and partially or completely shutting off the circulation. There are no *symptoms* distinct from those of the principal disease.

d. **Thrombosis** of the coronary arteries is a frequent result of disease in the coats of these vessels; and, owing to their small size, complete blocking and arrest of circulation through them are the ordinary consequences of this accident. The heart-substance, depending upon the occluded vessel for its vascular supply, quickly undergoes the atrophic changes of fibroid or fatty degeneration. Special *symptoms* are entirely wanting.

Disease or obstruction of the coronary arteries, with the ordinary consequences—fatty degeneration of the heart, and anæmia with white softening of the brain—are the conditions usually found in cases of permanently slow pulse.

e. **Syphilitic disease** of the coronary arteries has been recorded in a few instances, but its identification depended entirely upon the history and the concomitant symptoms, the deposit being histologically indistinguishable from ordinary atheroma.

Thomas Hayden.

CORPORA AMYLACEA (*corpus*, a body; and *amylum*, starch).—These minute bodies, which were described in this country by Dr. Quain and Dr. Hughes Bennett in the 2nd and 3rd vols. of the *Transactions* of the Pathological Society, were thus named by Virchow. They are generally only visible with the aid of the microscope, but sometimes are large enough to be seen by the naked eye, and now and then attain some size. Usually they are round or oval, and present a concentric, laminated arrangement, which is made more apparent by the action of acetic acid. They often have a yellowish tinge. In appearance corpora amylacea somewhat resemble starch-granules, and they are tinged brown or bluish by the action of iodine upon them. These bodies were formerly supposed to be composed of starch, and hence their name. This is not the case, however, and their actual chemical composition is not clearly known; it probably differs in different structures. Bodies resembling corpora amylacea in appearance and arrangement have been found in various parts, but they have attracted most attention in connexion with the nerve-centres, being particularly observed when these are the seat of atrophy or degeneration; they are also seen in the choroid plexus.

Frederick T. Roberts.

CORPORA QUADRIGEMINA, Lesions of.—The facts of comparative anatomy and experimental physiology tend to show that the corpora quadrigemina (*corpora bigemina* or *optic lobes* of the lower vertebrates) are in relation not only with vision and irido-motor co-ordination, but also with those functions which are, to a large extent, independent of the cerebral hemispheres, viz., equilibration and locomotor co-ordination.

The facts of human pathology, though not opposed to these data, cannot be made the basis of very precise conclusions as to the diagnostic indications of disease of these ganglia, as it is exceedingly rare to find disease limited to this region anatomically or functionally.

The corpora quadrigemina are, however, not unfrequently involved in lesions which invade neighbouring parts, such as meningitis—simple and tubercular, tumours, especially of the pineal gland and middle lobe of the cerebellum, &c.; but disease strictly limited to the corpora quadrigemina, such as local softening, is extremely rare, and hæmorrhage is unknown.

It is a fact agreed on by all experimenters that when the anterior tubercles, which are more especially connected with the optic tracts, are destroyed, vision is abolished, and that if the lesion is unilateral, the blindness occurs on the side opposite the lesion.

These phenomena in animals are in accordance with what has been observed in man. Dr. Bastian has recorded a case of total blindness, in which the cause proved to be softening limited to the anterior tubercles of the corpora quadrigemina (*Paralysis from Brain Disease*, p. 115).

It has been found experimentally in animals, and also in man, that atrophy of the opposite tubercle ensues when the eye has been destroyed. Irido-motor action is also paralysed by destruction of the corpora quadrigemina, a result which, however, is stated not to occur unless the injury is more than superficial and implicates the oculo-motor nuclei.

Disturbances of equilibration and co-ordination also result from lesion of the corpora quadrigemina. These are attributed to lesion of the subjacent tracts, and, according to Lussana and Lemoigne, more particularly to lesion of the subjacent superior cerebellar peduncle. For his own part, the writer thinks that all attempts at differentiation are pure hypotheses, and from the nature of the question must remain so. But, from whatever cause, there is no doubt that the disturbances alluded to do occur.

Irritation of the corpora quadrigemina on one side causes dilatation of the pupils and a hemi-opisthotonus of the opposite side, which becomes general if the irritation is prolonged or bilateral, the head being retracted and the legs extended, trismus also being very marked. According to Lussana and Lemoigne unilateral lesion of the corpora quadrigemima causes an incurvation of the trunk and gyration to the side of lesion. This would agree with the effects of irritation, being naturally a reversal of the phenomena. Clinical illustrations of these facts in the lower animals are difficult to find, for the reasons above mentioned; but a case reported by Dr. Duffin (*Clin. Soc. Trans.*, vol. ix., p. 187), which the writer had an opportunity of seeing and examining *post mortem*, is important in this relation. This was a case of tumour of the pineal gland, which, besides passing forward into the third ventricle, pushed underneath the aqueduct of Sylvius, stretching and causing atrophy of the corpora quadrigemina. The symptoms, in addition to those of cerebral tumour, viz., violent occipital headache and double optic neuritis, were double vision followed by loss of sight, vertigo, specially marked when the eyes were open, staggering gait, and tendency to retraction of the head and rigidity of the dorsal muscles. The pupils were large and sluggish. These symptoms, to a certain extent, resemble those caused by tumour in the middle lobe of the cerebellum, and it is a question how far these latter may be due to mechanical irritation of these ganglia. But we may infer that such a combination of symptoms as the above points to lesion of the corpora quadrigemina, or of the middle lobe of the cerebellum, though we cannot be certain of absolute limitation of the lesion.

Naturally the same secondary affection of the functions of the cerebral hemispheres occurs from tumours situated in this region, as in cases of tumours of the middle cerebellar lobe.

Pressure on the veins of Galen leads to dropsy of the cerebral ventricles, and its consequences on the cerebral circulation and functions.

D. Ferrier.

CORPULENCE (*corpus*, a body, and *lentus*, thick).—An undue accumulation of fat in the body. *See* Obesity.

CORPUSCLE (*corpusculum*, a little body).—In physiology and pathology this word is generally used as synonymous with cell. *See* Cell.

CORPUS STRIATUM, Lesions of.—The corpus striatum of English anatomy and pathology comprises various structures which have received special names, viz.: the *nucleus caudatus*, or intra-ventricular nucleus, which is exposed to view by laying open the lateral ventricle; the *nucleus lenticularis*, or extra-ventricular nucleus, consisting of three divisions, and subjacent to the convolutions of the Island of Reil; together with part of the *internal capsule*, or peduncular expansion, which forms part of the 'projection system' between the cortex and crus cerebri.

This differentiation is considered necessary, as it is believed that the effects of lesion of the corpus striatum will differ according to the part involved, although up to the present it cannot be said that this has been conclusively established. This is not to be wondered at considering the excessive rarity of lesions which have an exact anatomical and functional circumscription.

Physiological experiment, while thoroughly in harmony with clinical and pathological observations respecting the effects of lesion of the corpus striatum, has not succeeded in defining the functions of its several parts, if such differentiation exists, with any degree of precision. The statements made by some physiologists on the point, do not seem to the writer to rest on any satisfactory basis.

The corpus striatum is especially liable to lesion from embolism or rupture of its blood-vessels. These are furnished principally by the middle cerebral artery, which in the first part of its course sends off numerous straight twigs, which sink into the anterior perforated space, and supply this ganglion and the adjacent part of the optic thalamus. Owing to their position, and direction as regards the main current, they are easily ruptured or blocked up, and owing to their being of the nature of 'end arteries,' and almost destitute of anastomoses with other cerebral arteries, embolism rapidly leads to softening of the regions which they nourish.

Symptoms.—The symptoms of lesion of the corpus striatum may be divided into three groups or stages.

First stage.—This includes certain symptoms which are more or less transient, and depend chiefly on the suddenness of the lesion and functional disturbance of other parts.

To the latter belong the symptoms usually accompanying an apoplectic seizure (apoplexy), as also the loss or diminution of sensation on the opposite side of the body, which sometimes occurs in consequence of pressure on, or functional intetference with, the sensory tracts of the in-

ternal capsule by effusion into the corpus striatum. The symptoms due to the suddenness of the lesion of the corpus striatum as such, are complete paralysis of every voluntary movement on the opposite side of the body, occasionally varied by convulsive spasms of the paralysed side, and conjugate deviation of the head and eyes towards the sound side. This latter symptom is due to the centres for the head and eyes of the opposite hemisphere suddenly losing their antagonists. The temperature of the paralysed side is as a rule higher than that of the sound side. The total paralysis and flaccidity of the opposite side of the body, and conjugate deviation of the head and eyes, are transient symptoms, lasting from a few hours to a day or two.

Second stage. — This stage includes those symptoms which continue for a variable period, after those depending on the suddenness and disturbing effect of the lesion have passed off. They constitute the common type of hemiplegia or paralysis of voluntary motion on the side opposite the lesion. The face, arm, and leg, and to a certain extent the thoracic and abdominal muscles on the one side of the body, are affected. The paralysis does not affect all these parts equally. As a general rule it may be stated that those movements are most affected which are most independent of those of the opposite side, and which are most complex and delicate.

Hence the movements of the hand and arm are more affected than those of the face or leg, owing to the fact that these latter are more commonly exercised in associated or alternating action with those of the other side. The facial paralysis is most marked in the lower facial region. The orbicularis palpebrarum is more or less paretic, but never paralysed to the extent which occurs in Bell's or true facial paralysis, depending on lesion of the portio dura. The angle of the mouth on the paralysed side hangs lower, and the tongue deviates slightly to the paralysed side. The weakness of the facial muscles is best brought out when the patient smiles or tries to whistle. The face then becomes drawn to the sound side. While some volitional control may have been acquired over the leg, the hand and arm remain perfectly motionless.

In the process of recovery, the leg recovers before the arm, and as a rule the recovery proceeds from the proximal to the distal end of the limb, the shoulder and hip movements being regained before those of the hand or foot. The flexors regain their power before the extensors.

The sensibility of the paralysed parts is unimpaired; the superficial reflexes are diminished, the deep (tendon) reflexes increased.

The faradic contractility of the muscles is unimpaired, occasionally rather increased than diminished.

The muscles do not undergo atrophy except by disuse.

The temperature of the paralysed limbs, which at first is usually increased, is generally found to be lower than that of the sound side, to the extent of a degree, more or less.

Recovery may take place from all the symptoms of this stage, within a period varying from weeks to months, or the patient may pass into the third stage.

Third stage.—The special symptoms of this stage are the occurrence of what is termed 'late rigidity' in the paralysed limbs, a condition of evil import. This rigidity shows itself most frequently in the arm, but it is common enough in both limbs. The rigidity affects the flexors more particularly, and causes the limb to assume a position in which the flexors predominate. It is variable in degree and at first is capable of being overcome. At first also, it is remittent, tending to give way when the patient abstains from volitional efforts or from excitement, and seems almost gone on waking from sleep or when the patient yawns or stretches himself.

Gradually it assumes a more intense form, and the limb becomes permanently fixed and rigid.

After death, this condition is found to coincide with descending sclerosis of the motor tracts of the brain and spinal cord. The degeneration proceeds from the seat of lesion downwards through the crus, pons, pyramid of the same side, and then across to the posterior part of the lateral column of the spinal cord on the paralysed side. Frequently also, a similar track of degeneration is found on the inner aspect of the anterior column of the spinal cord, on the same side as the brain-lesion (Charcot, Türck, &c).

Even during the rigid stage, there is, as a rule, no trophic degeneration of the muscles or annihilation of faradic contractility, though the muscles waste from disuse unless artificially stimulated. But in some rare instances as Charcot has shown, the secondary degeneration invades the anterior cornua of the spinal cord, in which case amyotrophy or trophic degeneration of the muscles ensues.

There is no recovery from this condition.

Variations and complications.—Though general hemiplegia of the opposite side, without affection of sensation, is the type of disease of the corpus striatum, certain variations and complications have been observed, some of which still require elucidation.

When sensation is permanently affected along with voluntary motion, we have reason to regard the lesion as not confined to the corpus striatum, but as implicating also the posterior part of the internal capsule and the thalamus, an occurrence by no means rare. When the lesion affects only the grey matter of the nucleus caudatus, it is said that the hemiplegia is as a rule comparatively slight and transitory.

Similar affection of the nucleus lenticularis is said to produce more marked paralysis than that caused by affection of the nucleus caudatus, but also not of a permanent kind. When, however, the lesion causes rupture of the anterior two-thirds of the internal capsule, the hemiplegia is most marked and most enduring. It is this lesion only which gives rise to secondary degeneration of the motor tracts and permanent rigidity.

Cases are on record in which lesions of the corpus striatum have given rise, not to general hemiplegia of the opposite side, but to mono-

plegia, such as paralysis of the face or of one or other limb. We cannot yet say whether the lesions in these cases affected specially differentiated centres or medullary fibres, but that such may be the case is not impossible, though the subject requires investigation.

Cases are also on record of paralysis occurring on the same side of the body as the lesion. The real existence and explanation of such exceptional occurrences are still *sub judice*, and though various explanations may be suggested, it is well to wait for further instances, carefully investigated by accurate modern methods, before pronouncing definitively on the question.

Treatment.—It is unnecessary to discuss the treatment of lesions of the corpus striatum, as this is considered under the head of the various diseases of the Brain. D. Ferrier.

CORRELATION.—This term is used in medicine almost exclusively in reference to the ætiology of disease, and in this relation principally in regard to the zymotic diseases. The term 'correlation of the physical forces' may be taken as implying that the several forces are capable of being converted into or of giving place to one another when they are permitted to act under certain conditions, and that they are all related to a common cause. It is very much the same idea that is implied by the term 'Correlation of the Zymotic Diseases,' a subject which has recently been discussed in a separate work by A. Wolff.

It is contended that the several contagious diseases of a general type (the exanthemata) do not, necessarily and in all cases, reproduce their like; but that occasionally, the contagious particles thrown off from the same sick person suffering from some one of the diseases (*e.g.* scarlatina) may suffice to engender one or more different kinds of disease, according to the mode in which this matter operates—that is according as it may be swallowed, taken into the system through the pulmonary surface, or through some other mucous-membrane or skin abrasion. These diseases are said to be correlated, therefore, on account of this assumed relation to a common cause—a specific contagium. According to this notion the seat of primary action and the constitutional condition of the patient are factors which largely influence the form of disease which will ultimately manifest itself as a result of the contact of any given contagium. This view has at present scarcely passed beyond the stage of an ingenious speculation—though it is one which is by no means unworthy of further attention.

Diseases may be said to be correlated also when they are severally related to the same cause acting with different degrees of intensity. Thus it is held by some epidemiologists that the plague is only a malignant form of typhus; that yellow fever is due to a more intense form or action of the same poison as suffices at other times to engender intermittent or remittent fever; and that summer diarrhœa, cholerine, and cholera are also but different manifestations of one common though variable cause.

Similarly it is held by many surgeons that ordinary surgical fever, pyæmia, and septicæmia are correlated effects. They maintain that the appearance of one or other of these morbid states after a surgical operation is dependent in the main upon differences in the constitutional condition of their patients, and, moreover, that these forms of disease are further linked to one another by numerous intermediate states. This point of view has been both strengthened and extended of late, by some of the experimental researches of Dr. Burdon Sanderson. He found that the subcutaneous injection of different portions of the same inflammatory product, executed at the same time, would often produce quite different effects upon different animals of the same species. At one time a typical septicæmia proved rapidly fatal, at another a slower pyæmic process was established, whilst in a third animal the still more chronic process of so-called tuberculosis was set up. Here we get out of the region of speculation into that of fact.

The term correlation is only applicable to communicable diseases, otherwise its leading signification, viz. convertibility, could not be fulfilled. Hence it is that though very many diseases may arise from the operation upon different individuals of some common cause (such as exposure to cold), the maladies which may result from such a cause no one would think of speaking of as correlated.

H. Charlton Bastian.

CORROSIVE SUBLIMATE, Poisoning by. *See* Mercury, Poisoning by.

CORYZA (*κόρυζα*, a running from the head).—A synonym for nasal catarrh. *See* Catarrh.

COUGH.—Synon.: *Tussis*; Fr. *Toux*; Ger. *Husten*.

Description.—The *act of coughing* consists in one or more abrupt forcible expirations, accompanied by contraction of the glottis. First a deep inspiration is taken, the glottis is closed for a moment, and then it is opened by the pressure of the air forced out by the combined action of the thoracic and abdominal expiratory muscles. With the air thus suddenly expelled, any foreign matter that may be in the larynx or bronchi is driven into the pharynx or the mouth.

Ætiology.—The immediate cause of cough is the presence of an irritant, mechanical or sympathetic, affecting the surface of the air-tubes or the nerves that supply them, and it is the object of the cough to remove this source of irritation.

The sensibility of the respiratory surfaces is greatest at the commencement—the glottis being an ever-watchful janitor. It may be increased by congestion or inflammation, or by the continued act of coughing. Even the mere inhalation of cool or dry air may, in asthma or bronchial congestion, be sufficient to excite cough. The result of the irritation is to increase the natural secretion, and to alter its characters (*see* Expectoration).

Cough may be due to numerous reflex causes, such as gastric irritation, ear-disorder, or aneurismal or other pressure on the vagus, recurrent, or sympathetic nerves. The act may also be caused by a long uvula or enlarged tonsil; a granular state of the pharyngeal or laryngeal mucous membrane; polypi or other foreign

bodies in the larynx, trachea, or even in the external auditory meatus; various affections of the bronchial tubes—*e.g.*, undue dryness, hyperæmia, alteration in the quality or quantity of the bronchial secretion, or inflammatory affections; inflammation of the lung or pleura; or tubercle, cancer, or other growths in or near the lung.

Diagnosis.— Cough is not a disease to be treated, but a symptom to be traced to its source. An inspection of the pharynx and larynx and a physical examination of the chest will generally suffice to detect the cause.

The character of the cough is often quite pathognomonic—*e.g.*, the 'whoop' of whooping cough; the 'bark' of hysteria; the catching, painful cough of pleurisy; the slight 'hack' of early phthisis, and the equally distinctive cough of advanced phthisis with laryngeal ulceration; the loud clanging cough due to pressure on the trachea or laryngeal nerves; the spasmodic, suffocative cough of asthma.

The 'tightness' or 'looseness' of cough, indicating the absence or presence of secretion, is a valuable guide in diagnosis and treatment.

The *absence of cough* is no proof of the absence of serious lesion: while the presence of a few granulations in the lung is often productive of incessant and uncontrollable cough, long-continued destructive disease may exist without it.

Treatment.—Before prescribing for a cough it is of course essential to ascertain its cause; and the simplest and most innocuous remedies should be first used. The routine treatment of cough by sedatives is as injurious as is their use in diarrhœa. The secretions which ought to be removed are thus, in either case, locked up, and the irritation, which would have been transient, becomes established.

If the tonsils are found much enlarged, or the uvula pendulous and irritating the epiglottis, caustics or the guillotine will remove the evil. If a granular state of the pharyngeal membrane, dependent on torpid or engorged abdominal viscera, gout, or hepatic obstruction, exists, it may be treated by local astringents and general deobstruents.

A lax or congested state of the laryngeal membrane, due to overwork of voice, or the undue direction of attention to the vocal apparatus (clergyman's sore-throat), is best treated, according to the writer's experience, by the local application of iodine dissolved in spirit and olive oil. Undue dryness, simple hyperæmia, or hyperæsthesia of the respiratory mucous tract, may often be relieved by the act of sipping and slowly swallowing cold water, or the decoction of Iceland moss, fruit lozenges, gum arabic, liquorice, or linseed tea. Sucking ice or inhaling steam is very often all that is needed. In the early stage of catarrhal sore-throat, chlorate of potash in crystal, or in the form of lozenge, should not be neglected. The use of glycerine of tannin, or nitrate of silver dissolved in glycerine (half a drachm to one ounce) is of more service in relaxed throat than alum or tannin gargle; indeed, the free use of well-selected lozenges has rendered the employment of gargles well-nigh obsolete. The former can be constantly, the latter but seldom applied.

Medicinal treatment.—If it is desired to increase the fluidity of the secretion, squill or ipecacuanha may be used, or better still, tartar emetic in small doses, which is best given in effervescence with ammonia and citric acid. It must not be forgotten that syrups and nauseating expectorants are apt to do harm by enfeebling or disturbing digestion. Tincture of aconite in three-drop doses is often of value in allaying irritable cough, especially when fever is present. Gelseminum is the novel remedy for the same purpose. Of the direct sedatives, morphia is the most valuable; it proves of service in very small doses, $\frac{1}{12}$-gr. in a lozenge being often adequate. Conium, with or without morphia, suits some persons; hydrocyanic acid still more; and Indian hemp is also of value. The bromides, in combination with chloral, have recently gained great repute; the latter should be given with caution. The power of the bromide of ammonium in allaying spasmodic cough is remarkable. An emetic of ipecacuanha, sulphate of zinc, or mustard may be useful in relieving cough, by expelling secretion when this has accumulated in large quantity. If cough causes vomiting, food should be taken in small quantities, fluids should be limited, and a little capsicum or spiced brandy 'stays the stomach.'

External applications.—The use of counter-irritants must not be neglected. In the inflammatory stage of bronchitis, for instance, linseed and mustard poultices, and in the later stages, iodine or croton oil are of great use. The application of a small blister or vesicating fluid is a remedy not to be forgotten in some cases.

Inhalations.—Infusion of hops as an inhalation is a useful calmative; iodine is indicated in relaxed conditions in strumous subjects. Chloroform (10 to 15 minims) mixed with Eau de Cologne, and inhaled from a handkerchief, is useful in other cases. By means of the spray-inhaler, many non-volatile preparations may be applied to the respiratory passages. A solution of carbonate of soda is very useful in liquefying tenacious secretion. Tannic acid, alum, perchloride of iron, and nitrate of silver, are all valuable. Of sedatives, henbane, conium, camphor; and of antiseptics, sulphurous and carbolic acids are serviceable as inhalants. In chronic granular disease of the pharyngeal and laryngeal mucous membranes, the sulphurous waters of Aix-la-Chapelle, Aix-les-Bains, and St. Saveur in the Pyrenees, when inhaled in an atomised state, are of distinct service.

Patients may be thus *taught how to cough*:—Try to suppress the inclination, until the secretion that causes the cough is within reach, then take a deep and deliberate inspiration, and the accumulated phlegm is removed at a single effort. By inhaling steam from a hot sponge or basin of boiling water on first waking from sleep, the inspissated secretion, which is apt to be difficult to move, may be easily loosened and expelled. An ipecacuanha lozenge may serve a similar purpose.

E. Symes Thompson.

COUNTER-INDICATION. *See* Contra-indication.

COUNTER-IRRITANTS. — The term counter-irritation implies any irritation artificially established with a view to diminish,

counteract, or remove certain morbid processes which may be going on in a more or less remote part of the system. The substances employed in establishing this state are called counter-irritants, and may be classified as follows, according to degree of action:—1. Rubefacients; 2. Epispastics, vesicants, or blistering agents; 3. Pustulants.

Although some therapeutists have of late been disposed to question the value of counter-irritants, on the theoretical ground of inability to explain their mode of action, yet there is not wanting evidence, both from clinical observation and physiological experiment, that irritation in one part of the body may affect the functions and nutrition of other parts. That stimulation of the vessels of the surface can influence decidedly the circulation of deeper parts has been demonstrated by Dr. Brown-Séquard: for he found that irritation of the skin of the back, over the kidneys, caused a contraction of the arteries supplying those organs. From this experiment we can understand how a blister may relieve a sudden internal congestion in the lungs or brain, and how it may act in restoring tone to dilated and paralysed capillaries.

Revulsion and *derivation* are both examples of counter-irritation. In the first, the induced morbid action is set up in a part remote from the primary disease, as when mustard poultices are applied to the feet in an attack of apoplexy; in the second, derivative action is set up in the neighbourhood of the primary malady, as when a blister is placed on the back of the neck for the relief of cerebral disorder.

Rubefacients. — *Action.* — These remedies, applied to the skin, produce local warmth and redness from increased flow of blood in the cutaneous vessels. The local hyperæmia thus induced subsides gradually on ceasing to employ the rubefacient; but sometimes, when the action of this has been prolonged, the epidermis may peel off, and more or less local soreness remain. Rubefacients are usually quick in action; their local after-effects are trifling; and they may, therefore, be applied without injury over a large extent of surface.

Enumeration and Application.—Examples of rubefacients are found in Ammonia and Ammoniacal Liniments or Embrocations; Mustard Plasters and Liniment; Volatile Oil of Mustard; Oils of Turpentine and Cajuput; and Iodine. Hot water is at times applied on a sponge or flannel to produce a speedy counter-irritant and derivative effect in relieving sudden internal congestion and spasm, as in the early stage of croup, laryngitis, and laryngismus stridulus. The Cataplasma Sinapis, or mustard poultice, is a useful and rapidly-acting rubefacient in inflammation, spasm, and neuralgic pain. Dr. Garrod recommends a very useful sinapism, made by mixing 10 minims of volatile oil of mustard with 1 oz. of spirit of camphor, and sprinkling this on impermeable piline. Rigollot's mustard leaves, and the Charta Sinapis or mustard-paper of the Pharmacopœia, applied to the skin, produce a speedy rubefaction of the surface. Vinegar should not be added to mustard poultices; but by mixing some oil of turpentine or a little powdered capsicum in a mustard poultice, its rapidity of action as a stimulant and rubefacient can be greatly increased. Where, on the other hand, a gentle stimulation with warmth and moisture to the surface are desired, as in some cases of pneumonia, a linseed-meal poultice may be used, with its surface sprinkled lightly over with mustard-meal. Generally twenty minutes is as long as an ordinary mustard poultice can be safely borne on the skin. In persons who have a very delicate skin, a layer or two of muslin should be placed between the mustard application and the surface of the body. In applying mustard poultices to those who are unconscious of pain, caution is necessary, for it has happened that the poultice being left on for a long time has produced dangerous ulceration and sloughing of the surface. A mustard foot-bath is at times employed with a view to a revulsive and counter-irritant effect. To prepare a mustard bath, two tablespoonfuls or more of mustard should be tied in a cloth, and agitated well with cold water; then hot water may be added to make the bath. It is found by experiment that cold water extracts the active principle or volatile oil of mustard far better than very hot water does.

Uses.—Rubefacients are used in chronic inflammation and irritation of the mucous surfaces, as in bronchitis, and irritation about the air-passages. Troublesome cough, in cases of phthisis, is often relieved by applying tincture of iodine, or acetic acid and turpentine liniment, to the chest. Rubefacients are of service in removing lingering irritation about a joint, their use also tending to promote the absorption of chronic thickening or effusion in the joint; but friction with a rubefacient liniment over a joint must not be employed till all active inflammatory action has entirely ceased. Various degrees of persistent counter-irritation may be maintained by applying, after the skin has been well cleansed with soap and water, the Emplastrum Picis or Emplastrum Calefaciens of the Pharmacopœia. A mustard plaster applied to the nape of the neck has proved useful in cases of irritable brain with sleeplessness. The same application made to the foot or great toe is a valuable revulsive where gout attacks more important organs. A mustard plaster has the advantage over a blister in rapidity of rubefacient action; and, from the sharp pain caused, the mustard plaster is preferable when it is a matter of moment to rouse one who is in a state of lethargy or torpor from narcotic poisoning by opium, or alcohol, or from coma in the course of a fever. Where we wish to exercise a prolonged action over chronic inflammation in an organ, we should use a blister rather than a sinapism.

Vesicants, Epispastics, or Blistering Agents.—*Action.*—A blister acts primarily as a rubefacient and powerful stimulant to the cutaneous vessels. The papillæ of the skin become reddened and raised; minute vesicles soon appear on these elevations; and these, gradually coalescing, form a bleb, or large vesicle, containing an albumino-fibrinous fluid.

Enumeration and Application.—The agent most commonly employed for blistering purposes is Cantharis or Spanish fly, in the several preparations to be found in the Pharmacopœia; but there are other agents that have been used for a

similar object. Glacial Acetic Acid applied to the skin produces intense redness and pain, with rapid vesication, but its action may extend deeply as a caustic, and cause a troublesome sore. Liquor Ammoniæ dropped on a piece of lint, applied to the skin, and covered with a watch-glass, very soon causes redness and rapid vesication in most persons. This is a good way of raising a blister when it is desired to apply powdered morphia endermically to relieve severe pain.

The application of blisters should not be made directly over an inflamed part. There is some evidence to show that a strong stimulus applied very near an inflamed organ may increase the paralytic dilatation of its capillaries, and so add to the disease. Blisters should not be applied where the skin is loose, nor over any prominence of bone, nor to the breast during pregnancy. It should moreover be borne in mind that the cantharidine of a blister may be absorbed by the skin, and act on the kidneys, producing strangury and bloody urine. This accident may be obviated by sprinkling powdered camphor over the blister before placing it on the skin, or a thin piece of silver paper may be interposed. In persons of feeble vitality, a blister left on too long time has been known to induce dangerous sloughing.

When vesication is specially desired, there is no need to leave the blister on for twelve hours or more, for it may be removed at the end of six or eight hours, and a warm linseed poultice applied. If the blister be opened, which is best done by pricking the most dependent part with a needle, sweet oil and cotton-wool is the best dressing. The practice of maintaining a blister as a running sore or *exutoire*, by applying irritating ointments, is not often resorted to now. The process causes great pain and exhaustion of the system, and is one rather of depletion than of counter-irritation. In the case of children, blisters should be used with caution, being kept on till the skin is well reddened, when they should be replaced by a poultice. It is also a good plan not to open the blister, as the effused serum forms the best dressing for the excoriated surface, and by following this plan the child is saved much worry and pain.

Uses.—In its primary action a blister acts as a local stimulant, but when it remains on long enough to produce extensive vesication and discharge of serum, it acts as a depletive and depressing agent. This primary and secondary action of blisters has been much insisted on by the late Dr. Graves of Dublin, who found great benefit in cases of fever with apathy and prostration from the application of *flying blisters* to various parts of the surface. Thus a blister over the præcordial region, kept on for about one hour, and then removed, was observed to rouse and stimulate a flagging heart. In other cases the flying blister might be placed at the chest or back, or else behind the head on the neck. Care should be taken not to leave the blister on long enough to cause vesication, and the size of the blister should be fairly large.

Vesication by a blister is of service in many brain-affections attended with congestion and tendency to serous effusion, such as in the chronic stages of hydrocephalus, and non-tubercular meningitis. In hysterical paralysis narrow strips of blister placed completely round the affected limb have proved curative. A strip round the throat may cure nervous aphonia. A strip of blister one inch wide will sometimes stay the spread of erysipelas along a surface. In cases of pleuritic or pericarditic effusion the repeated application of blisters to the chest-wall is of manifest advantage. In effusions into joints (hydrarthrosis) blisters aid absorption; and it has seemed to the writer that absorbent remedies, such as iodide of potassium, often begin to do good as soon as a blister appears to have once set the absorptive process in action. In the joint-affections of acute rheumatism, 'the blister treatment' has attracted notice. Armlets and wristlets of blister-plaster are applied close to the inflamed joints during the fever, and the serous discharge from the blister is kept up by means of linseed-meal poultices.

In the obstinate acid vomiting of gouty patients, a blister over the epigastrium often gives relief. Some forms of neuralgia, as for example pleurodynia, may yield to a blister over the seat of the pain. At times obstinate pleurodynia, or mastodynia, can be relieved by flying blisters applied in the vertebral groove on the affected side, where a tender spot can often be detected on pressure. Blisters should be avoided in cases of renal and vesical inflammation, as the absorption of the cantharidine may increase the mischief.

Counter-irritation by heat.—The skin can be rapidly blistered by applying a hammer or a small flat iron heated in a spirit-lamp or boiling water. The skin is tapped for a few seconds with the hammer, just to induce redness of the part. In some forms of rheumatism, neuralgia, and spinal weakness, this practice has been followed by satisfactory results. Vesication of the skin by the *ferrum candens*, or hot iron, has been used in chronic joint-disease.

Moxas are used for the purpose of causing severe counter-irritation. European moxas are made either with cotton wool soaked in solution of nitrate of potash, or of the pith of the sunflower, which naturally contains this salt. A wet rag is placed on the skin; in the centre of this is a hole in which the lighted moxa is placed, which gradually burns down to the skin and produces an eschar which in due time separates by suppuration. In spinal affections, and in some forms of paralysis of the sensory and motor nerves, moxas are said to have done good; but their application is very painful, and now they are seldom employed.

Pustulants.—*Action.*—The agents belonging to this class of counter-irritants produce a pustular eruption on the part of the skin to which they are applied.

Enumeration and Application.—Among pustulants may be placed croton oil, tartarated antimony, and strong solution of nitrate of silver. When croton oil is applied to the skin, it acts as an intense irritant, producing an eruption which is at first papular but very soon becomes pustular. Tartarated antimony in the form of ointment, or in hot aqueous solution, is a powerful counter-irritant, producing pustules which resemble those of variola. When applied thus it may, by becoming absorbed, induce symptoms of

gastro-enteritis. It should not be applied to parts usually uncovered, as the pustules leave marks behind them; and under all circumstances the remedy, being a painful one, must be used with caution. Strong solution of nitrate of silver will produce pustulation, but it is seldom employed for this purpose.

Issues have long been used as counter-irritants. An issue is formed by placing on the skin a piece of adhesive plaster, in a hole in the centre of which a fragment of caustic potash is inserted. The caustic causes an eschar, and when this has come away an issue-pea is placed in the cavity left by the eschar; this pea acts as a foreign body, and keeps up suppuration. One drachm of pus may be discharged daily by an issue; more than this is too great a drain on the system. An issue requires to be dressed daily, and when it has been long open and running it must not be healed too suddenly. Issues over the spine have been found useful in chronic spinal disease; and in some chronic brain-affections, with hyperæmia and congestive tendency, an issue in the back of the neck or in the arm is frequently of service.

Setons.—A seton is made by passing a narrow-bladed knife under a fold of skin and then carrying a few silk threads through the incision by means of a probe or long needle. The threads remaining in the wound prevent it from healing, and maintain a free purulent discharge. Setons are used for the same purposes as issues, and they have proved useful in certain intractable forms of headache—the seton being inserted in the skin of the neck. Setons have been used in cases of cystic bronchocele with thickened walls; in chronic inflammation of the bladder; in many chronic affections of the uterus; in various chronic skin-diseases of an obstinate character; in chronic inflammations of the eye, and ulcerations of the cornea; and in the early stages of pulmonary phthisis.

In acute affections issues and setons are never employed, and they should not be placed over any part where there is much movement, as a troublesome sore may be the result. It is necessary to bear in mind that issues, setons, and pustulants are, like blisters, when kept on long enough to induce serous discharge, of the nature of evacuants. They carry off nutrient material from the blood, and therefore are more or less depressing and exhausting to the system, and their repeated or protracted employment will tend to induce the irritative fever of debility.

JOHN C. THOROWGOOD.

COUP DE SOLEIL (Fr).—A synonym for sunstroke. *See* SUNSTROKE.

COW-POX. *See* VACCINIA.

COXALGIA (*coxa*, the hip, and ἄλγος, pain).—Pain in the hip-joint. *See* JOINTS, Diseases of.

CRACKED-METAL or CRACKED-POT SOUND (*Bruit de pot fêlé*). A peculiar sound elicited by percussion, and resembling that emitted on striking a broken jar or a metallic vessel. *See* PHYSICAL EXAMINATION.

CRAMP.—This name is applied to certain painful varieties of tonic spasm. In its most familiar form it affects the calves of the legs coming on principally at night, on the occasion of some slight movement of these parts. The affected muscles, mostly on one side, contract with such energy as to give rise to a board-like rigidity, together with sensations of an agonising character. The attack rarely lasts more than a minute or two, though it may more or less speedily recur. It is perhaps best cut short by a vigorous but steady voluntary contraction of the opposing extensor muscles of the foot. Where it is more obstinate than usual, firm pressure around the thigh or upon the great sciatic nerve, sometimes gives relief. Cramp is often associated with some irritation of the stomach or of the intestines, especially in children or delicate nervous persons. In this way it is produced not infrequently when arsenic in medicinal doses has been continued for some time, and is beginning to exert a slightly poisonous effect upon the system. In a more general form it often occurs, to a marked extent, in cholera. Other forms of painful spasm are by no means common, if we except colic. *See* also SPASM. H. CHARLTON BASTIAN.

CRANIOTABES.—*See* SKULL, Diseases of.

CREPITANT (*crepito*, I make a noise).—When applied to a body, this word signifies that it is capable of yielding the sensation or sound of crepitation. It is also associated with a râle, to indicate a peculiar character which it possesses. *See* PHYSICAL EXAMINATION.

CREPITATION (*crepito*, I make a noise).—A sensation or sound of crackling. It may be observed in morbid states of the bones, joints, or subcutaneous tissue; but the term is more frequently applied to a physical sign connected with the lungs. *See* PHYSICAL EXAMINATION.

CRETINISM (*creta*, chalk).—SYNON.: Lat. *Cretinismus*; Fr. *Crétinisme*; Ger. *Cretinismus*; Ital. *Cretinismo*.

DEFINITION.—A condition of idiocy arising from endemic causes, associated with imperfect development and deformity of the whole body, varying however in degree.

This condition of physical and mental degeneracy is not limited to any nationality. It obtains in the great mountain-chains of Europe, Asia, and America. In Europe it is met with in the valleys of Switzerland, Savoy, and Piedmont, and it abounds in the neighbourhood of Salzburg, Styria, and the Tyrol. It is less frequently met with in the Pyrenees and in the valleys of the Auvergne in France. Even in England it has been met with in various parts, among others in the dales between Lancashire and Yorkshire. Although more frequently met with in valleys it is not unknown on plains which are subject to inundations.

DESCRIPTION.—The degrees of cretinism are numerous. A residence in one of the valleys where this affection exists, enables one to trace the various steps of degeneracy, commencing with those who are taking part in the industrial life of the valley, down to the helpless individuals who are leading only a vegetative existence.

The typical cretin presents a marked physical

conformation. He is stunted in growth, rarely reaching five feet in height. His skin is of a tawny yellowish hue, thickened and wrinkled; and looks as if too large for the body. There is also a great increase of subcutaneous areolar tissue. His tongue, large and thick, with hypertrophied papillæ, always displays lessened power of co-ordination; and often hangs from the mouth. The mouth is partly open, margined by thick fissured lips, and with the saliva running over the chin. The face is large; the lower jaw is drooping, and its angle obtuse. The eyes are often affected by strabismus, obliquely placed, and small; and the lids are commonly puffy. The belly is pendulous from the laxness of the skin. The lower limbs are generally short and deformed, and the gait is waddling. The head is deformed, the forehead retreating, the top flat, and the occipital region ill-developed. The cranium is brachycephalic. The nose is broad and flattened. Puberty is often delayed to the twentieth year. The mammæ in the female are large and pendulous; the same remark applies to the genitals in the male. The intellectual faculties are imperfectly developed. The cretin is often unable to speak, and his hearing is frequently defective. The affection is usually associated with more or less enlargement of the thyroid gland. His viability is low, few living beyond thirty years of age. The sexual functions are abnormal; masturbation is frequent; and the subjects of cretinism are often impotent.

Ætiology.—The conditions for the development of cretinism are hereditary predisposition; the action of deteriorating influences on the parents, such as unwholesome dwellings and non-nutritious diet; and accidental causes operating on the infant during the period when its physical and intellectual life are developing. The last-named causes are atmospheric and possibly geological conditions, peculiar to special localities. Humidity of the soil and air in valleys where there is little interchange of the atmosphere, and the existence of magnesian limestone in the soil, are probably the most potent factors. Cretinism is not met with as an endemic disease on elevated plateaux, nor in cold countries where sudden changes of temperature are uncommon. Goître is a frequent accompaniment of cretinism, and would appear to be developed under the same conditions. The cases of cretinism met with in England present features which are indicative of a scrofulous origin. There is a condition of idiocy associated with arrest of growth and development at the period of first dentition, not unfrequently met with in England, which has been termed *Sporadic Cretinism*. Some of these cases have been traced to alcoholism on the part of the progenitors, and are usually associated with an absence or atrophy of the thyroid body. There is reason to believe that children become cretinoid when taken to reside, at the period of their early development, in localities where the disease is markedly endemic. There are numerous, well-attested instances of healthy women living during their pregnancy in cretinic districts bringing forth cretinoid children, who removing from such localities, propagate healthy children. By far, however, the greater number of cretins arrive at their helpless condition by successive steps of degeneracy in their ancestors. It has been thought that cretinism was due to premature ossification of the cranial sutures, especially of the spheno-basilar suture; and that this was caused by drinking water largely charged with lime. It is impossible, however, to regard this premature ossification, when it does occur, as other than one of the outcomes of the malady and not its cause. Moreover there are numerous examples where the synostosis is deferred instead of being premature.

Anatomical Characters.—Pathological anatomy shows that the bones of the cranial vault are thickened and without diploë. The basilar groove is generally wanting. The foramina for the passage of arteries and nerves are somewhat smaller than natural. The occipital fossæ are flatter than usual, as if the flattening had resulted from a compression of the cranium from above downwards. Every variety of deformity of the cranium is met with of the brachycephalic type. The brain is usually small, unsymmetrical, pale, and infiltrated with serum. Premature synostosis is occasionally met with at the spheno-basilar suture, and with it a rectangular form of the base of the skull; this, however, cannot be regarded as a constant condition.

Diagnosis.—The diagnosis of cretinism may be made in childhood, from the slowness of the development of the body, the stupid expression, the postponement in the evolution of the teeth, and of the ossification of the fontanelles and sutures, the tawny yellow colour of the skin, the thick and goitrous neck, the slavering, and the delay of speech and of walking.

Treatment.—This consists in removing the child as early as possible from the circumstances which have produced the disease. He should be taken to a locality where the soil is dry and porous, and should have frequent baths with friction to the surface of the body. The diet should be of the most nutritious kind—a diet into which animal food largely enters. The administration of cod-liver oil and of the lacto-phosphate of lime and iron is indicated. Early education should be commenced as to habits of cleanliness, followed by systematic physical exercise of the various muscles. All intellectual advancement must be sought for through the improvement in every way of his physical condition. The lower animal life may thus be supplemented, if earnest efforts are used, by increased capacity for rational enjoyment, and a more or less useful existence.

J. Langdon Down.

CRIMINAL IRRESPONSIBILITY.—Historical Summary.—A medical opinion as to the condition of an accused person is often necessary in order to determine whether he or she can be held accountable for criminal acts. Such an opinion generally depends on the presence or absence of insanity, or on the connection which may be traced between this mental condition and the act in question. In the article on Legal Insanity it is explained that it is only within a comparatively recent period that insanity has been admitted as an excuse for crime, except in those comparatively rare cases in which, as Justice Tracey expressed it in 1723, a person does not know what he is doing, 'no

more than an infant, a brute, or a wild beast.' *See* INSANITY, LEGAL. This view fairly represents the state of public and of legal opinion until the later years of the eighteenth century. The subsequent enlightenment of the public mind did not receive juristic expression until the trial of Hadfield in 1800, when Erskine first enunciated the doctrine, that 'delusion where there is no frenzy or raving madness is the true character' of such insanity as implies irresponsibility. The most important case in the history of this question was that of Bellingham, who was executed in 1812 for shooting Mr. Spencer Perceval. In this case Lord Chief Justice Mansfield said, that if a person labouring under mental derangement were capable in other respects of distinguishing right from wrong, 'he could not be excused for any act of atrocity which he might commit.' 'It must be proved beyond all doubt,' he added, 'that at the time he committed the atrocious act he did not consider that murder was a crime against the laws of God and nature.' The trial of MacNaughton in 1843 for the murder of Mr. Drummond led to the most authoritative statement of the law which has ever been obtained in this country. MacNaughton was acquitted on Chief Justice Tindal's direction that the point for the jury to consider was whether 'at the time the act was committed' the accused 'had that competent use of his understanding as that he knew that he was doing by the very act itself a wicked and a wrong thing.' The general application of this doctrine would have greatly enlarged the area of irresponsibility, and its enunciation at that time produced considerable surprise and even consternation. The matter was indeed regarded as so urgent that the House of Lords immediately ordered a series of questions to be laid before the fifteen judges with the view of settling the state of the law. In the answers to these questions it was in substance laid down, that to entitle an accused party to acquittal on the ground of insanity it is necessary that he be of diseased mind, and at the time he committed the act not conscious of right or wrong; or, that he be under some delusion which made him regard the act as right. But this statement has been far from effecting a final settlement of the question.

Most writers on medical jurisprudence have insisted that the real criterion of responsibility is the freedom of the will, or the power of the individual to control his actions. This has been more or less advocated by Esquirol, Marc, Ray, Pagan, Jamieson, Mittermaier, and Von Krafft-Ebing. Esquirol dwells strongly on the importance of the freedom of the will. Ray includes it in the comprehensive statement which has received the approval of so many medical jurists. 'Liberty of will and action,' he says, 'is absolutely essential to criminal responsibility, unless the constraint upon either is the natural and well-known result of immoral or illegal conduct. Culpability supposes not only a clear perception of the consequences of criminal acts, but the liberty unembarrassed by disease of the active powers which nature has given us, of pursuing that course which is the result of the free choice of the intellectual faculties.' Pagan observes that the 'loss of control over our actions, which insanity implies, is that which renders the acts which are committed during its continuance undeserving of punishment.' Jamieson puts the question: 'Had the lunatic at the time of committing the deed a knowledge that it was criminal, and such a control over his actions as ought, if it existed, to have hindered him from committing it.' Dr. Taylor says: 'The power which is most manifestly deficient in the insane is generally the controlling power of the will'; and he expresses the opinion that 'we have here a fair criterion on which responsibility or irresponsibility may be tested.' Dr. Bucknill's view is substantially the same. 'Responsibility,' he says, 'depends upon power, not upon knowledge, still less upon feeling. A man is responsible to do that which he can do, not that which he feels or knows it right to do. If a man is reduced under thraldom to passion by disease of the brain he loses moral freedom and responsibility, although his knowledge of right and wrong may remain intact.' The latest German code puts responsibility upon the same basis. 'An act is not punishable,' according to it, 'when the person at the time of doing it was in a state of unconsciousness; or of disease of the mind, whereby free volition was prevented.' Mittermaier and Von Krafft-Ebing sanction the attempt to render the meaning of 'free volition' more definite by describing it as made up of *libertas judicii* and *libertas consilii*, freedom of judgment and freedom of choice. Casper somewhat obscurely defines criminal responsibility as 'the psychological possibility of the efficacy of the penal code.' Mr. Balfour Browne, a recent writer, gives as the best definition 'a knowledge that certain acts are permitted by law, and that certain acts are contrary to law, and, combined with this knowledge, the power to appreciate and be moved by the ordinary motives which influence the actions of mankind.' Dr. Guy thinks that every person who is insane must be regarded as wholly irresponsible, and that the law of England ought to be assimilated to that of France in the declaration that: 'Il n'y a ni crime ni délit lorsque le prévenu était en état de démence au temps de l'action. Mr. Warren, on the other hand, suggests that a person should not be held irresponsible unless he were as 'unconscious of his act as a baby.' Dr. Maudsley and others hold that the determination of responsibility in cases where insanity is alleged depends on whether a connection can or cannot be traced between existing disease and the act.

Insanity has been pleaded as an excuse for acts of theft; but such cases are rare, and never occur except where the social position of the accused adds importance to the decision. Indeed it may almost be said that the plea is never raised, except in order to avoid capital punishment. Hence it is, that in the discussions which have arisen the question has been intimately associated with the law of murder and homicide. A special inquiry into the state of this law by a committee of the House of Commons[1] has consequently given occasion to the enunciation of important views as to the legal relations of insanity

[1] Report of Select Committee of the House of Commons on the Homicide Law Amendment Bill, July 21, 1874.

and responsibility. Evidence was furnished to the Committee by Lord Chief Justice Cockburn, Baron Bramwell, Mr. Justice (now Lord) Blackburn, and Sir James Fitz-James Stephen. The immediate object of the Committee was to examine a bill drawn by Sir James Stephen for the codification of the law of homicide. In the clause of the bill which deals with the relations of disease and responsibility, homicide is stated to be 'not criminal if the person by whom it is committed is at the time when he commits it prevented by any disease affecting his mind—(*a*) from knowing the nature of the act done by him, (*b*) from knowing that it is forbidden by law, (*c*) from knowing that it is morally wrong, or (*d*) from controlling his own conduct.' But it is stated to be 'criminal, although the mind of the person committing it is affected by disease, if such disease does not in fact produce one of the effects aforesaid in reference to the act by which death is caused, or if the inability to control his conduct is not produced exclusively by such disease.' It was, however, proposed in the bill that, 'if a person is proved to have been labouring under any insane delusion at the time when he committed the homicide, it shall be presumed, unless the contrary appears or is proved, that he did not possess the degree of knowledge or self-control hereinbefore specified.' That is to say, where delusion exists, the burden of proving moral capacity would be shifted, the prosecutor having to prove its existence, instead of the accused having to prove its absence. The opinions elicited during the enquiry showed that the law is regarded by legal authorities as being at present too uncertain in its operation, and as failing to recognise some of the most important elements in the question. The divergent character of the recommendations which were made showed, however, that legal opinion is much divided not only as to the proper relations of insanity and crime, but also as to the essential elements of responsibility. In the meantime, therefore, the statements of the fifteen judges after the MacNaughton case remain the chief exposition of the English law where insanity is pleaded in excuse for crime.

Present state of the question.—It is necessary, in order to justly appreciate the present aspect of the subject, thus to trace its more recent history, and it would be useful, did space permit, to present an estimate of the comparative value of the several tests or criteria which have been proposed for the determination of cases in which insanity has been alleged. These criteria may be broadly summarised in the following six propositions. According to one view a person should be held irresponsible for an act if at the time of committing it (1) he laboured under insanity of any kind or degree; according to another, if (2) he laboured under delusion; or (3) if he was ignorant of right and wrong; or (4) had not power to appreciate and be moved by ordinary motives; or (5) had lost the controlling power of the will; or (6) if the act is traceable to, or its nature has been determined by mental disease affecting the agent. The last of these views is the only one to which fatal objection may not be raised both on the theoretical and practical sides. The others are all too vague to be of much advantage; and they rather tend to introduce new difficulties than to remove those already existing. The proposition therefore which seems to approach nearest to a solution of the difficulty is that irresponsibility must be admitted whenever the act is traceable to, or its nature is determined by mental disease affecting the agent. It will of course be understood that under such a rule the term 'mental disease' must be held to include both congenital and acquired disorders: arrest of development being as much a morbid condition as functional or structural change. This view of the subject may not be ultimately accepted in the precise terms of the proposition here given; but the principle on which it rests seems to afford the only safe basis upon which we can go. As has already been shown, it has not hitherto been regarded in this light by the majority of the judges; but there have been indications of late years that judicial views are tending in that direction. The late Lord Wensleydale and others have given sanction to the principle in their judicial statements. And the present Lord Justice-General of Scotland (Inglis) gave definite expression to it in one case (*Brown*, Sept. 1866). He told the jury that the main question was 'whether the prisoner was in such a state of insanity at the time, as not to be responsible for the act which he had committed', and in order to constitute such insanity he said that 'it must be clearly made out that at the time of committing the act the prisoner was labouring under mental disease in the proper sense of the term, and that that mental disease was the cause of the act.' In America the doctrine has been frequently acknowledged, but never more fully and tersely than by Judge Doe, of New Hampshire (*State v. Pike*), who comprehensively defined the medical relations of both criminal irresponsibility and civil incapacity, when he stated that 'a product of mental disease is neither a contract, a will, nor a crime.' One important point is to prevent persons from being punished for actions which are the direct outcome of pathological processes. But it is of equal importance to avoid the adoption of a principle which would make the existence of slight mental irregularities incompatible with responsibility. There does not appear to be any danger of this in acting on the principle which is here enunciated. For it lies in the very nature of the cases in which the doctrine could be applied, that the condition to which it is proposed that irresponsibility should be attached must be one which is known to exhibit itself in acts of serious and even criminal character. If the trained observer of disease is able to recognise in an act—which is ordinarily followed by severe punishment—a direct result or a characteristic feature of a morbid process, of the existence of which there may otherwise be sufficient proof, the question of responsibility cannot present any serious difficulty. It may admit of doubt whether a person is responsible for not controlling his actions, or for not knowing right from wrong, or even in some cases for the harbouring of a delusion. But once let it be proved that an act is the natural result of a disease under which a person is known to labour, and the question must be

practically removed from the field of discussion. Before, however, the principle can be accepted as fully satisfactory, it is necessary to enquire whether its application would permit insane persons to be held responsible who ought not to be so considered. In other words, are there states of insanity in which a person is irresponsible for acts to which he has not been predisposed or impelled by the insanity? It is perhaps impossible to give such an answer to this question as would be both definite and complete; but for practical purposes we think it may be answered in the negative. Where the insanity is of such a nature that it does not modify the whole conduct, we believe it will be found in practice necessary to admit the existence of responsibility for acts where there is no demonstrable connection between them and the mental disease. The insane persons who on this principle might be held responsible, would be found solely among those whose irresponsibility could only be admitted after very searching enquiry, and whose insanity was of that kind and degree which has often been declared by medical writers to be consistent with responsibility. It is not to be supposed that under this rule difficulties would cease. It would often be hard to show in cases of actual disease that there was good reason for believing in its existence, or that it was really contributory to the act committed. This, however, would not result from any defect in the principle, but from that imperfection of our knowledge which renders the perfect application of any principle impossible. Let the task of the medical witness be limited to the demonstration of facts indicative of disease and its consequences, and he will at least be acting quite within his special province and might expect that reasonable weight would be attached to his opinion. And if juries were instructed that the law does not hold a person responsible for acts committed under the influence of disease, it is scarcely conceivable that anyone would be found guilty where good cause had been shown even for the reasonable supposition of such an influence. Whatever may be the view ultimately adopted, it would seem to be in every way desirable that the attention of the medical expert should be confined to the elucidation of the medical facts, and that he should not be required to deal with questions which are legal and abstract, and in no way specially medical. The condition known as *diminished responsibility* has not been alluded to in this article. It is only indirectly recognised by British law, and therefore, though much is to be said in favour of its recognition, it is unnecessary to deal with the subject here.

JOHN SIBBALD.

CRISIS (*κρίσις*, a decision, a turn).—Crisis is a term applied to the rapid defervescence of an acute febrile disease. It has wandered somewhat from its original meaning, which was 'judgment,'—primarily an operation in the mind of the observer, but reflected upon the phenomena observed. The converse term, employed to designate a gradual subsidence of fever, is *lysis*.

Crisis formed at one time the basis of an important medical doctrine. Certain days from the onset of the disease on which the crisis commonly occurred were considered to be propitious. The seventh day was especially favourable, while the sixth was the most unfavourable; speaking generally, the odd numbers or the multiples of 7 were propitious, and even numbers and such odd numbers as stood near multiples of 7, such as 19, were unpropitious. The preparation also for a crisis was indicated and the critical day foretold by remissions perceptible some days previously. The whole morbid process of fever was represented as a process of elaboration by which a *materies morbi* was prepared for expulsion, and an essential feature of the crisis was a critical evacuation, by means of which this was eliminated.

The doctrine of crisis and even of critical days was not pure imagination or superstition, but was founded originally on careful observation. In times when nothing was known of the organic lesions which give rise to fever, and in countries where a large proportion of the diseases were of a malarious origin, it would afford data for prognosis and conduce to appropriate treatment; and at the present day in hot climates a crisis is anxiously looked for in febrile attacks on a given day, and, as is well known, a critical fall of temperature and improvement in the general symptoms precede in pneumonia improvement in the physical signs.

In order to constitute a true crisis the defervescence should occupy less than forty-eight hours, and it often takes place in a much shorter time. The fall of temperature should be accompanied by a corresponding reduction in the frequency of the pulse, and should coincide with a feeling of relief and a return of strength; the skin will be warm and soft, the tongue moist, and there will be indications of reviving appetite; there may or may not be a critical evacuation, but the secretions will become more natural in amount and character.

This favourable mode of termination of an acute febrile disease is more common than is usually supposed. The circumstances under which it is most likely to occur are when the attack begins abruptly and the temperature rises rapidly, the natural course of the disease being short and not attended with organic lesions, such as will of themselves keep up fever. After twenty-one days, termination by crisis is not to be expected. The more marked the onset, as, for example, by a definite rigor, the more rapid the rise of temperature and the greater the height to which it reaches, the greater the probability of an early critical termination.

OCCURRENCE.—The diseases in which the conditions favouring a crisis are realised, and in which this mode of termination is observed, belong to various classes.

Among the *specific fevers*, eruptive and continued, it occurs frequently in variola, but in severe cases it is interfered with by the febrile disturbance excited by the eruption. In measles it is very common: in scarlet-fever a true crisis is seen only in mild cases, though the onset of this disease is peculiarly abrupt. The mode of termination of typhus is essentially critical, but as a rule the crisis is not sharp. Relapsing fever affords the best examples of crisis, which is moreover attended by a critical evacuation in

the form of profuse perspiration, the temperature sometimes falling 10° F. in as many hours, and the patient passing from a state of extreme suffering and oppression to almost perfect ease and comfort. In enteric fever *lysis* is the mode of termination.

Remittent fevers often present crises, which may be true and curative, or false and illusive; and the sun-fever and common continued fever of hot climates, and tropical diseases generally, have a tendency to fever running high very early and breaking abruptly at a critical period.

In this country *feverish colds*, attacking the throat or taking the form of influenza or catarrh, often terminate critically in three or four days. Erysipelas may so end, but at a later and less definite period. The sharp *febrile attacks* which sometimes occur *after childbirth* often exhibit a very decided crisis. In *pneumonia* the natural termination is by a well-marked crisis, which may take place as early as the fifth day, or be deferred to the ninth, after which a critical termination is not to be expected, and the suspicion may be entertained that the case is not one of frank pneumonia, the prognosis becoming grave. As has been already stated, the general improvement precedes the indications by physical signs of resolution in the inflamed lung. Pleurisy is said also to terminate critically, but it is not in the same definite way as pneumonia.

The *critical evacuations* which entered into the original notion of a crisis are really a common attendant. The most common is a profuse warm perspiration, which may occur whatever the disease may be. Occasionally the evacuation is a copious flow of urine, or it may take the form of diarrhœa. Epistaxis or hæmorrhoidal flux is a more rare and doubtful critical evacuation. A common critical phenomenon is a prolonged, sound, and refreshing sleep.

The question whether or not a favourable crisis affects the odd rather than the even days has been a frequent subject of dispute, and it still remains undecided. It is not, however, of any importance; but another point handed down with the doctrine is worthy of attention, namely, that indications of an approaching crisis are often given two or three days beforehand in slight remissions of fever. By the presence or absence of such remissions at a certain period of the attack, or by a continuous rise of temperature where a remission might be expected, important prognostic information may be afforded and indications for treatment obtained.

Therapeutic Indications.—The main therapeutic deduction from a study of crisis as a termination of acute disease is, that we should not hastily interfere with the reactions by which the system adjusts itself to altered conditions or meets the incidence of the causes of such disease, but contribute to their completion. We do not assume the existence of a *vis medicatrix* tending invariably to the restoration of health; but we must recognise the power inherent in a living organism to respond by internal changes to external influences, and to regain the balance when this has been disturbed. In this process a certain cycle of changes must be gone through, and the great opportunity for treatment of an active kind, should any be required, arises when the course, direction, and probable duration of these changes are known, and when agencies can be brought to bear at a given moment, which will contribute to bring about the appropriate critical evacuation or a critical sleep, through which a return to a normal condition would naturally be effected.

William H. Broadbent.

CRITICAL.—Having relation to a crisis. *See* Crisis.

CROUP. — Definition. — Croup is a word which, in accordance with its etymology, originally meant *stridulous breathing*, a symptom, therefore, of laryngitis stridulosa, laryngismus stridulus, œdema of the glottis, laryngo-tracheal diphtheria, and other affections which permanently or spasmodically contract the chink of the glottis. It was imported from the Scottish vernacular into medical nomenclature by Dr. Francis Home, of Edinburgh, in 1765, when he published a tract of 60 sparsely printed pages, entitled *An Inquiry into the Nature, Cause, and Cure of the Croup*. It has since drifted into very strange and very different meanings. 'In France,' to quote the Dictionary of Littré and Robin, 'it is a term now generally reserved for *tracheal diphtheria*:' in Germany, it is applied to *membranous deposits on the internal surface of organs*, such expressions as 'croup of the uterus' and 'croup of the intestine' being in current use: in Great Britain it is used, as employed by Home, Cheyne, and their followers, to designate a disease which they believe to be distinctive and separate, but which is declared by an increasing number of British physicians, the followers of Bretonneau, to be a mere literary composite of diseases pathologically different from one another. In a general way, the question—What is croup?—has now been answered. It is necessary, however, still further to explain the position which 'croup' at present holds in the literature and science of British medicine.

In 1826 Bretonneau of Tours, by the publication of his work entitled *Recherches sur l'Inflammation Spéciale du Tissu Muqueux, en particulier sur la Diphthérite*, created the name, and first pointed out, in that and subsequent writings, the true pathology of diphtheria. He did not, however, describe a new disease. He only disentangled it from other diseases in which it had been mixed up in description. Modern literary research has shown that diphtheria has at intervals prevailed, under various names, in many countries, from the earliest medico-historical times. Home, in his little monograph, describes only eight cases; and of these, all of which he calls by the name of 'croup,' five are manifestly tracheal diphtheria, and three are cases of laryngitis. As no false membrane was seen in the three cases of laryngitis, he concluded that it had been absorbed, or that the treatment had prevented its formation! For a long period his successors, British and foreign, continued to make similar mistakes; and indeed till Bretonneau published the result of his clinical study, the error now adverted to was universally accepted as the truth. In 1801, Dr. John Cheyne of Edinburgh published his *Essay on Cynanche*

Trachealis, or Croup, a pamphlet of 80 pages illustrated by five excellent plates, the work of the illustrious Charles Bell. Cheyne, like Home, has confounded together infantile laryngitis and infantile tracheal diphtheria in one disease, which he calls 'cynanche trachealis or croup.' He attributes the recoveries from the former to the energy of the bleeding and purging; and the deaths from the latter to the imperfect adoption of that treatment. Dr. Cheyne's essay contains only ten cases. In the history of the five which terminated in recovery, nothing is said of false-membranes having been seen; and in four of the five which terminated in death, there was found false-membrane, which is well depicted by Charles Bell in the coloured plates. If the account now given of the constantly quoted, and often misquoted, little tracts be correct, where is the foundation for the statement reiterated up to the hour at which we write by a succession of British authors, that the said writings of Home and Cheyne contain the description of an individual disease—croup—possessing essentially different features from the laryngeal and tracheal diphtheria of Bretonneau?

It must be admitted that, while the inference to which the preceding remarks are intended to lead is in accordance with the views of some eminent British physicians, it is at variance with the teaching of others who claim respectful attention. Dr. Charles West, in the edition of his *Lectures on the Diseases of Infancy and Childhood*, published in 1874, when discussing 'Diphtheria or Angina Maligna,' says:—'I have come to the conclusion which I long hesitated to adopt, that what differences soever exist between croup and diphtheria, they must be sought elsewhere than in the pathological changes observable in the respiratory organs. The mere extent of false-membrane in the air-passages certainly affords no ground for a distinction between the two affections, though I think it is more common to find the false-membrane reaching to the tertiary bronchi in diphtheria than in primary croup.' In these sentences he intimates his belief in a non-diphtheritic membranous croup—a disease which many maintain has no existence, except in books. In the same work, in the lecture on croup, he says:—'It can scarcely be necessary to tell any of you that *croup* is the English name for the disease designated by scientific writers *cynanche trachealis* or *cynanche laryngea*. It consists in inflammation, generally of a highly acute character, of the trachea or larynx, or both, which terminates in the majority of cases in the exudation of false-membrane, more or less abundantly, upon the affected surface.'—(Lecture xxiii. p. 390, 6th edition, London, 1874.) The only case of croup given by Dr. West in the lecture is one which, if Bretonneau's teaching be correct, is a typical case of diphtheria affecting the air-passages. The case and the sentence by which it is introduced, are subjoined:—

'The danger,' says Dr. West, 'of being lulled into security by the apparent improvement of a child who has been attacked by croup, is so serious that before proceeding to consider the treatment of the disease, I will relate to you a case by way of caution. On June 25, a little girl, four years old became hoarse and lost her appetite, though she did not appear otherwise ill. On the 27th, she seemed less well, and in the night was very restless, and had difficulty of breathing. On the 28th, respiration was more difficult, and though she had but little cough, she seemed sometimes in danger of choking. In the night a croupy sound accompanied her breathing, and violent attacks of dyspnœa were of frequent occurrence. On the 29th, she was taken to a surgeon, who gave her some medicine, after each dose of which she was sick; and this sickness was followed by much relief, and by an almost complete cessation of the croupy sound. This improvement was thought to have continued during the 30th; the child slept quietly during the night, and was considered so much better by her parents that she was brought by them to the Children's Hospital at 9 a.m. on July 1. As she lay in the lap in a sitting position, her countenance was pale and livid, her respiration was sibilant, her surface cool, her pulse very frequent and feeble; but she did not appear to be in any of the distress usual in the advanced stages of croup. At 9 a.m. she was admitted; at 6 p.m. she died, though no great distress nor violent struggle for breath preceded her death. The extensive deposit of false-membrane in the trachea and bronchi showed that in spite of her apparent amendment for a season, disease must all the time have been advancing, unsuspected by her friends, overlooked even by her medical attendants.'

This case, given by Dr. West as a case of the disease which he calls croup *in contradistinction to diphtheria*, will be regarded by the medical profession in France, and by all other followers of Bretonneau, as a typical and graphically described example of diphtheria implicating the air-passages. They will say that it was typical in its manner of invasion, in its course and duration, in its being relieved by emetics, in the anæsthesia and asphyxia proclaimed by quietude and the pale lividity of countenance observed nine hours before death; and finally, that it was typical in the extensive deposit of false-membrane in the trachea and bronchi.

In illustration of the remarks made at the beginning of this article on the meanings of the term *croup*, it is well to remind the reader that Dr. West's case, now quoted, will be called *croup* by French physicians, for they reserve that name for the manifestation of diphtheria in the air-passages.

Ætiology.—The disease which Home, Cheyne, West, Sansom, and many other older and recent British authors of repute call *croup*, is an acute inflammation of the larynx or trachea, or of both, which, when it runs its natural course, generally, they say, terminates in membranous exudation on the inflamed mucous surface. The affection which Bretonneau, Trousseau, Peter, Barthez, Sanné, and the entire modern school of French physicians, call *croup*, is the membranous manifestation in the larynx and trachea, or in both, of diphtheria, a general asthenic disease. The French physicians, with whom agree George Johnson, Semple, and other British physicians, including the writer, hold that membranous exudation is never a result of simple acute inflammation, or, in other words, that there is no such disease as the croup of Home, Cheyne, West, and

Sansom, these authors having blended two essentially different diseases in one description.

No statement could have been written intelligibly in respect to the ætiology of 'croup,' without these prefatory remarks. The subject now admits of being very briefly disposed of. Diphtheritic croup, that is to say, the croup of French authors, is considered in the article DIPHTHERIA. The common exciting causes of inflammations of the larynx and trachea are exposure to chilly winds and cold damp air; and the sudden transitions from mild to cold wet weather. Cold wet places are those in which inflammations of the larynx, trachea, bronchi, and pulmonary parenchyma are most prevalent. The much greater frequency of these affections among children in the northern and eastern coasts of Great Britain than in the southern is attributable to the greater rigour of the climate in the former regions. In some localities in northern Europe inflammation of the air-passages is said to prevail at times among children as an epidemic. Perhaps a somewhat exaggerated impression exists as to the greater proportion of cases of inflammation of the larynx and trachea in young children, because in them it generally causes stridulous breathing. The chink of the glottis being very small in young children does not admit of being narrowed by turgidity of the mucous membrane without the causation of stridulous breathing to a greater or less extent. Even a slight catarrhal affection of the larynx and trachea, by exciting spasm, causes stridulous or 'croupy' breathing in a very young child, whereas a somewhat acute inflammation accompanied by considerable swelling of the same parts often runs its course in the adult without producing noisy breathing or alarm.

TREATMENT.—The treatment of diphtheritic croup is described in the article DIPHTHERIA.

Inflammation of the larynx and trachea, like inflammatory affections of the other parts of the air-passages and lungs, requires to be treated by antiphlogistic measures. When the inflammation is acute, active remedies are called for. Some physicians do not hesitate in such cases to bleed from the jugular vein, taking as much as three ounces of blood from a child two or three years of age. Others, including the writer, abstain from this heroic proceeding, under the conviction that although it often produces apparent temporary benefit, it is a benefit always fraught with evil. The strength is dangerously reduced; a fatal issue may be precipitated; and when recovery does take place, the course of convalescence is slow and difficult. It seems safer, and every way better, to subdue the inflammation by blisters and carefully watched doses of ipecacuan and tartar-emetic. If the affection be only moderately sthenic, it is prudent first to use the ipecacuan by itself: there are many cases, however, in which the antimonial must not be withheld. Too large a dose of tartar-emetic may give rise to alarming depression. Should such a state be induced, the best means of averting danger is watchfully to administer a little brandy, and apply a small blister—say an inch and a half square—over the sternum about two inches below the manubrium, a warm moist linseed poultice being placed over it for three or four hours. Even when no depression has been occasioned by drugs, a succession of small blisters to the chest is of great use. Signal benefit is often obtained by a short and smart purging with calomel and scammony. In all cases, the legs must be kept enveloped in warm wrappings, moist warmth being preferred if it can be unflaggingly maintained.

In most cases, the breathing is subject to dyspnœal paroxysms arising from spasm of the glottis. The muscular relaxation which follows the emetic action of ipecacuan or tartar-emetic generally relieves this spasm with rapidity and for some hours. The vomitive effort is also useful in another way—in clearing the air-passages from dangerously accumulating mucus, and so admitting more air into the lungs. When bronchitis and broncho-pneumonia are associated, as frequently happens, with the laryngeal and tracheal inflammation, the treatment is the same as that which has been already described. In protracted cases, and in weak children, it is nearly always necessary to give, for a longer or shorter period, brandy or some other alcoholic stimulant. Ammonia too is generally indicated. The extent to which stimulants are demanded varies with each case, and also with the varying circumstances of each case. Milk ought to be the principal aliment. Beef-tea, and arrowroot made with milk or with brandy, may also be given from time to time.

Should diphtheria be prevalent when we have under treatment cases of common inflammatory sore-throat, we must be specially on the outlook for the supervention of the former. Not in cases of simple inflammatory sore-throat only, but still more in the sore-throat of scarlatina and measles, diphtheria frequently supervenes as a secondary disease, suddenly declaring itself by an exudation of false-membrane in the air-passages. A new principle of treatment must be adopted when diphtheria engrafts itself on the original inflammation. We have then to treat an asthenic general disease as well as the throat-affection.

The possibility of the supervention of diphtheria, with its accompanying prostration of strength and dyscrasia of the blood, is another argument in addition to those already mentioned against the abstraction of blood in the common laryngo-tracheal inflammations of young children.

[The article on DIPHTHERIA should be read in connection with this article.]

JOHN ROSE CORMACK.

CROUP, FALSE.—A term commonly applied to laryngismus stridulus. *See* LARYNX, Diseases of.

CROUPOUS, CROUPY (Scot. *croup*, to croak).—These terms were originally employed with reference to the peculiar crowing or stridulous character of the respiration, cough, and voice in certain affections of the larynx, and signified 'belonging to croup' in its clinical relations; for example, 'croupy cough,' 'croupous symptoms.' When morbid anatomy demonstrated the occurrence of a fibrinous exudation or false membrane upon the affected

surface in a special form of croup, the word 'croupous' was used also to designate this false membrane; thus, 'croupous exudation' and 'croupy membranes.' The application of the term was afterwards further extended; and it is now employed to indicate the process that leads to a fibrinous exudation in any situation whatever; such as 'croupous inflammation,' and 'croupous pneumonia.' Thus the words "croupous' and 'croupy,' which were originally associated with peculiar sounds, have come in a remarkable manner to express certain physical, chemical, and microscopical characters in the products of inflammation. *See* Croup, Diphtheria, and Inflammation.

CROWING CONVULSION.—A popular synonym for laryngismus stridulus. *See* Larynx, Diseases of.

CRURA CEREBRI, Lesions of.—From anatomical and physiological considerations we should be prepared to find that a solution of continuity of the crus cerebri would interrupt the sensory and motor tracts for the opposite side of the body. And, further, as the roots of the third nerve pass through the inner aspect of the crus to their nucleus underneath the aqueduct of Sylvius, there is considerable danger of their being implicated in a lesion of the crus.

Hence we should expect, in consequence of such a lesion, a form of alternate paralysis, viz., oculo-motor paralysis on the side of lesion, and paralysis of voluntary motion and sensation on the opposite side. A typical instance of this form of paralysis has been put on record by Weber (*Med. Clin. Trans.* 1863). In this case there was oculo-motor paralysis on the side of lesion, and complete paralysis of voluntary motion and partial paralysis of sensation on the opposite side. The partial escape of the sensory tracts is accounted for by the fact that the sensory tracts are situated more to the outer and back part of the crus, and hence tend to escape destruction from a lesion situated in such a position as specially to endanger the continuity of the third nerve.

Vaso-motor paralysis on the hemiplegic side also occurs in a marked degree, and the temperature of the paralysed side may be two or three degrees above that of the other.

D. Ferrier.

CRUSTA LACTEA (*crusta*, a crust, and *lactea*, milk-like); milk-crust.—A synonym for eczema pustulosum of the face and head, met with in infants at the breast. *See* Eczema.

CRUVEILHIER'S PARALYSIS.—A synonym for progressive muscular atrophy. *See* Muscular Atrophy, Progressive.

CUPPING.—This is a mode of treatment sometimes employed to relieve congestion or inflammation of internal parts by drawing blood to the surface of the body. When the blood thus attracted to the superficial parts is actually abstracted from the body by means of incisions, the operation is called *wet*-cupping, and this has been described in the article Blood, Abstraction of. We shall here describe *dry*-cupping, in which no scarifications are made, the blood being simply drawn towards the surface by atmospheric exhaustion, hyperæmia of the subcutaneous parts or organs being thereby relieved.

Formerly cupping was extensively practised, but of late years it has fallen into disuse. In some respects it serves the purpose of, but has a more powerful effect than, counter-irritants; rapid and marked results being sometimes produced upon the circulation of inflamed or congested tissues.

Modes of Application.—Dry cupping is performed as follows:—The flame of a spirit-lamp, being allowed to burn for an instant in the dome of a cupping-glass, is quickly withdrawn, and the cup is then rapidly and evenly applied to the skin over the affected part. The heat expands the air contained in the glass cupola, and, owing to the contraction which ensues on cooling, the skin is forcibly sucked up into the cup. It is well first to sponge the skin of the selected spot with hot water, so as to render it more supple and vascular; slightly moistening the rim of the cupping-glass helps to increase the degree of exhaustion.

An excellent modification of cupping, which has been demonstrated to the writer by Dr. Quain, is practised in the following way:—Instead of allowing the cup to remain stationary after its application to the skin, as is usual, the operator dexterously slides it to and fro along the surface. When the operation is to be thus performed the amount of surface drawn into the glass must not be considerable. In this way a large tract of skin may be quickly rendered hyperæmic without effusion of blood into its meshes, as happens when the cups are stationary.

Precautions. — Cupping-glasses should be applied where the skin is thick and cushiony, as over the loins, nape of the neck, pectoral region of the chest, &c., and not where bony prominences, or other irregularities, are likely to interfere with complete exhaustion. The edges of the glasses should not be so hot as to burn the skin.

Uses.—Cupping may be advantageously employed in sthenic cases of cerebral congestion, the cups being applied to the nape of the neck; in hyperæmia of the spinal cord; and in inflammation or congestion of the lungs, kidneys, or other viscera. In renal ischæmia it is eminently serviceable. This may be owing to the fact that the blood supply of the skin of the loins is in intimate relation with that of the kidneys; the vascular supply to those organs being thus directly and immediately influenced.

Alfred Wiltshire.

CUTIS, Diseases of. *See* Skin, Diseases of.

CUTIS ANSERINA (*cutis*, the skin, and *anser*, a goose). A state of roughness of the skin, resembling that of a goose when plucked, produced by prominence of the pores or follicles. It is due to contraction of the muscular structure of the corium, and is commonly occasioned by cold.

CYANIDES, Poisoning by.—*See* Antidote; and Prussic Acid, Poisoning by.

CYANOSIS (*κυανὸς*, blue).—This which is really not a disease, refers to the peculiar blue or more or less livid colour of the surface of the body, especially in certain parts, which is observed in several affections that interfere with the circulation and oxygenation of the blood. The condition is most commonly associated with, and reaches its highest development in certain forms of congenital malformation of the heart, for which consequently cyanosis is not uncommonly used as a synonym. Lesser degrees of similar discolouration are, however, not infrequently noticed in cases of cardiac disease developed after birth, and they may also accompany pulmonary affections which materially obstruct the circulation; a cyanotic appearance is also one of the obvious effects resulting from all modes of suffocation, and it is observed in the collapse-stage of cholera. The upper half of the body may become extremely cyanotic as the result of obstruction of the superior vena cava. For the pathology of cyanosis, *see* HEART, Malformations of.

CYNANCHE (*κύων*, a dog, and *ἄγχω*, I strangle). SYNON.: Fr. *Angine*; Ger. *die Bräune*.

This word is used to express an inflammatory condition of the throat, or contiguous parts, in which difficulty of breathing or of swallowing exists, accompanied by a sense or feeling of choking. The term is used synonymously, more frequently on the Continent than in England, with *Angina*; an affix, indicative of the seat or nature of the affection, being employed as a designation for each of the several forms or varieties of disease affecting the throat or adjacent parts. Such, for example, are the terms Cynanche *laryngea*, or croup; Cynanche *maligna*, or malignant sore-throat; Cynanche *parotidea*, or mumps; Cynanche *pharyngea*, or inflammation of the pharynx; and Cynanche *tonsillaris*, or quinsy. *See* these several diseases.

CYRTOMETER (*κύρτος*, a curve, and *μέτρον*, a measure).—An instrument for measuring the absolute and relative dimensions of the chest-wall. *See* PHYSICAL EXAMINATION.

CYSTICERCUS (*κύστις*, a bladder, and *κέρκος*, a tail).—DESCRIPTION.—Cysticercus is a bladderworm furnished with a head which is distinctly visible to the naked eye. The form usually found in man is specifically identical with the so-called pork-measle, or *Cysticercus* (*telæ*) *cellulosæ*. According to Dr. Giacomini, however, the human measle commonly displays 32 cephalic hooks, whilst the pork-measle carries 24; moreover, in the human variety there is a greater adherence of the measle to its investing capsule. The only other form of cysticercus at present known to infest the human body is the slender-necked bladder-worm, or *Cysticercus tenuicollis*. An alleged example is preserved in the anatomical museum attached to King's College, London. This parasite is of frequent occurrence in the sheep.

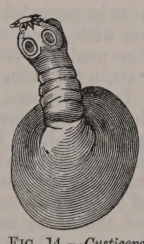

FIG. 14.—*Cysticercus* (*telæ*) *cellulosæ*, removed from the human eye by Mackenzie. × 5 diameters. After Allen Thomson.

SITUATIONS AND SYMPTOMS.—The clinical importance of the human measle is chiefly due

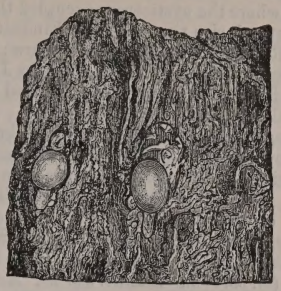

FIG. 15.—Portion of measled pork, showing *Cysticerci*. Nat. size. After Lewis.

to the circumstance that it is apt to take up its residence in the brain and eye; those parasites occupying the cerebrum being for the most part situated in the grey or cortical substance. The only serious attempt that has been made to establish diagnostic signs by which brain-cysticerci might be detected during life is that initiated by Griesinger, who based his conclusions on data supplied by the histories of upwards of fifty cases. Symptoms are exceedingly variable. In some cases they are altogether wanting; in a second set, epilepsy exists, without mental disturbance; in a third set, epilepsy is accompanied with mania or imbecility; in a fourth set, mental disturbance may occur without epilepsy; whilst in another group there is neither epilepsy nor mental disturbance, until shortly before death, when symptoms of irritation or torpor gradually supervene. Since Griesinger has himself remarked that the epileptiform seizures due to cysticercus are in all respects like ordinary cerebral epilepsy, and since also 'the psychical disturbances have nothing characteristic about them,' the practical physician is naturally tempted to conclude that diagnosis and curative treatment are alike impracticable. The writer, however, objects to that inference, on grounds too wide for discussion here; but, as one source of encouragement calls attention to the fact that cysticerci are not very long-lived. He has demonstrated that a period of eight months is amply sufficient for the setting in of calcareous degeneration, a process which involves the speedy death of the measle. If therefore the presence of cysticerci be so much as suspected in the brain, the prospect of a natural cure is by no means hopeless. Rest, both mental and corporal, would of course tend to assist nature's efforts.

Cysticerci may develop in any part of the human body; their most frequent situation being the subcutaneous, areolar, and intermuscular connective tissues. Amongst the more remarkable cases are five recorded by Heller, and one by Greenhalgh, where they occupied the lip; by Fournier, where several occurred in a boil; and one by Dupuytren, where the parasite lodged in the great peroneus muscle. Mr. R. Davy lately recorded a case in which several were present in the arm; but the well-known multiple cases given by Giacomini, Hodges, Delore, and others, show that hundreds of measles may co-exist in the same human host. In Delore's

case there were about 2,000, of which no less than 84 were found in the cerebrum! Of instances where the cysticercus occupied the eye we may particularise the cases by Windsor, Logan, Estlin, Rose, and Mackenzie of Glasgow; whilst of additional brain-cases, those given by J. Harley, Hulke, Burton, Bouvier, Frèdault, and Toynbee are particularly noteworthy.

Amongst the most recent contributions to our knowledge of cysticerci are the memoirs of Perroncito (*Della panicatura negli animali*, in *Annali del. R. Accad. d'Agricolt. di Torino*, 1872); of Bécoulet and Giraud (*Bull. de la Soc. Méd. de Gand*, 1872), of Giacomini (Sul. *Cyst. cell. hominis* e sulla *Tænia med.* &c., 1874), of Lewis (*Report on Bladderworms*, &c., 1872), and of Pellizzari, as reported by Dr. Tommasi in his Italian edition of the writer's manual of the parasites of our domesticated animals (*Appendice Parasiti*, &c. *Vermi*, 1874). A summary of these last-mentioned researches was given by the writer in the *Lond. Med. Record* for 1874 (p. 641). Lastly, it is important to bear in mind that small hydatids, which are also liable to take up their abode in the brain, may very readily be mistaken for cysticerci, after death; and during life they are apt to give rise to precisely similar symptoms. The writer has collected records of more than thirty cases where bladderworms occurred in the human brain. References to most of these are given in the *Bibliography* of his Introduction to the study of Helminthology (*Entozoa*, 1864; and *Supplement*, 1869). *See* BLADDERWORMS.

T. S. COBBOLD.

CYSTINE or CYSTIC OXIDE (*κύστις*, the bladder).—A peculiar substance occurring either in solution or in the form of small crystals in the urine, or as calculi in the urinary passages. *See* URINE and CALCULI.

CYSTITIS (*κύστις*, the bladder).—Inflammation of the bladder. *See* BLADDER, Diseases of.

CYSTS.—DEFINITION.—The word cyst (*κύστις*, the urinary bladder) is used in pathology for a closed cavity containing fluid or soft matter. The nature of the wall is unimportant; it may be newly formed or a pre-existent structure. The objects thus defined differ much among themselves, and are associated together rather from convenience than on account of any real pathological similarity.

CLASSIFICATION.—Cysts may be classified according to their structure, as simple or compound; according to their contents, as serous, mucous, fatty, etc.; or according to their mode of origin. The latter, though not free from objection, is the basis of description which will be here adopted. Cysts may originate (1) from *dilatation* of previously existing closed cavities; (2) from *retention* of products of secretion; (3) from *exudation*, or the metamorphosis of exuded products; (4) as a part of *new-growth*; (5) by a vice of *development*; and, finally, (6) from the growth of *parasites*.

1. **Cysts from Dilatation.**—Spaces, normal or newly formed, in connective tissue may, by irritation and consequent excessive exudation, be converted into cysts; or the same result may happen from the confluence of several such spaces. In proportion as the wall becomes smooth, and the shape uniform, they may be called cysts. Bursæ, whether normal or pathological, are cysts. Ganglion in the sheath of tendon is clearly a pathological cyst. To these and like structures the name *Hygroma* has been given. They all contain clear serous fluid, and are lined by an endothelium. Hydrocele, or dilatation of the tunica vaginalis testis—an affection probably always due to a low form of inflammation—is another instance. One class of ovarian cysts comes under this head, those, namely, which are due to simple dropsy of the Graafian vesicle. Tubo-ovarian dropsy has the same explanation; and cysts of the broad ligament are enlargements of normal structures which are left as relics of the development of the ovary. The thyroid gland seems from its structure, containing, as it does, so many closed follicles, particularly disposed to this kind of cyst-formation, and this is doubtless the explanation of bronchocele.

2. **Cysts from Retention.**—Cystic formations may result from the obstruction of the natural outlet of a secreting organ, and the consequent retention of secretion. It is necessary that the walls of the secreting cavity should admit of enlargement, and that the tension should not become so great as to check secretion.

All secreting glands present instances of such cysts. The sebaceous glands of the skin are particularly liable to obstruction of their duct, and in this way are formed sebaceous cysts, miliaria, and comedones; the contents of which are sometimes epithelium and the products of normal secretion, sometimes abnormal products, such as pus. *See* FOLLICULAR DISEASES.

The glands or mucous surfaces are liable to similar obstructions, and *mucous cysts* result, such as are sometimes seen in the mouth. Large cysts in the mouth (*ranula*) result from the obstruction of the ducts of the salivary glands or are perhaps connected with an abnormal production of gland-substance. The stomach very frequently, other parts of the intestinal canal more rarely, show similar cysts, which, when they project and become complicated in structure are called polypi. They are occasionally seen on the larynx and trachea. In no part are mucous cysts more frequent than in the uterus, where indeed, similar formations, the *ovula Nabothi* must be regarded as normal. The varieties here met with have, as Virchow has pointed out, close analogy with the various forms of retention cysts in the skin.

In the mamma, cysts may result from the cutting off of portions of the gland-follicles, but the cysts contained in mammary tumours are not always formed in this way, some being part of new growths. In the testicle obstruction and cutting off of seminiferous tubes may lead to small cysts, but these are more often connected with new growths. The curious cysts known as *spermatocele*, containing spermatozoa, appear to arise from a similar distension of detached portions of testicle-substance, which, by an error of development, have failed to become connected with the excretory ducts. The testicle is also liable to general cystic degeneration, usually called cystic sarcoma. Cysts of the kidney are of various

kinds, but many, no doubt, both large and small, result from the dilatation of uriniferous tubules and capsules of glomeruli when their outlet is obstructed, as occurs in the cirrhotic form of Bright's disease. The origin of the very numerous microscopic cysts has been much disputed. The writer inclines to the belief that they arise from moniliform contraction of the uriniferous tubes, especially such as contain the hyaline cylinders, known as fibrinous casts. Another form of cystic disease of the kidney is developmental. In this the whole of the organ is converted into a mass of cysts, and is usually much enlarged. This condition may be congenital, and the organ may be so large as to obstruct parturition. It is attributed by Virchow to inflammation of the calyces during intra-uterine life.

To guard against a common error of language, it should be pointed out that the condition of the kidney which results from the obstruction of the ureter, or of the urinary passages lower down, though sometimes called cystic dilatation of the kidney, is not properly a case of cyst-formation, and is better called *hydronephrosis*.

3. Cysts from Exudation.— Exuded materials, such as blood and inflammatory products, may, by a process of degeneration, central softening, and external fibrous formation, become converted into imperfect cysts, as is seen in the metamorphosis of a blood-clot in the brain, and in the termination of some abscesses. But since the accumulation of fluid does not go on continually, the tension in such cavities is slight, and they do not approximate to a globular shape.

4. Cysts from New-Growth.—In many forms of new-growth cysts are produced, but not always in the same way. Sometimes, as in myxoma and enchondroma, they result from softening of portions of new-growth already formed. In many sarcomata, the production of new tissue goes hand in hand with that of cysts, and is sometimes effected as in glandular organs, by the formation of new follicular structures without an outlet, sometimes by new-growth into the dilated cavities. Polypoid or pedunculated growths on a free surface may sometimes, by the fusion of their extremities, enclose spaces which become converted into cysts. We do not, however, find cysts forming by themselves a new-growth of so definite a character as to deserve a separate name.

5. Developmental Cysts.—These include (*a*) *compound ovarian cysts*; (*b*) *dermoid cysts*. Cysts are met with in the ovary which come under none of the definitions just given, viz., the so-called *compound multilocular cysts*, which constitute the well-known formidable cystic disease of the ovary, and sometimes produce tumours of immense size. In these the originally simple primary cyst appears to become complicated by the formation in its walls of secondary cysts, which may encroach upon or project into the primary. Again there may be papillary growths starting from the inner wall of the primary cyst, which either fill it up, or by fusion enclose spaces, which become secondary cysts. Very complicated structures thus result. The contents may vary in consistence and colour, from clear, pale, albuminous liquid to gelatinous matter, and may be stained through hæmorrhage, or purulent through inflammation. The origin of these structures, which have no precise parallel in other parts of the body, is extremely obscure. It is not even certain whether the primary cysts commence, as might seem *primâ facie* highly probable, in the Graafian follicles; but they are plainly due to an error of development, possibly beginning in early intra-uterine life, and are not set up by any external causes. The presence of a tubular gland-tissue, such as is found in the rudimentary, but not in the perfect ovary, confirms this view, by throwing cyst-formation back into an early stage in the development of the organ.

In another, but rarer form of cystic disease of the ovary, equally due to an error of development, and sometimes congenital, the whole organ is found converted into a mass of small cysts, with no striking inequality of size. This variety resembles one form of cystic disease in the testicle and kidney.

Dermoid cysts are those containing sebaceous matter, and which are lined by a layer of flat cells resembling epidermis. The wall may be complicated with connective tissue, forming papillæ resembling those of true skin, and may contain hairs, sebaceous glands, either in connection with them or unattached, and sudoriparous glands. The accumulation of fatty matter within the cysts is doubtless the result of the continuous activity of the sebaceous glands, the products of which cannot escape. Large masses of hair may also be found, from continuous growth, and there are often numerous detached epidermic scales. Such a cyst has only the characters of a portion of skin, which might be imagined invested and included by the growth of the surrounding parts in an early stage of development—an explanation formerly entertained.

These simple dermoid cysts are sometimes complicated by containing teeth, it may be in very large numbers (*dentigerous cysts*), but since teeth may also be regarded as cutaneous products, the cyst may still have originated in the skin. This explanation no longer holds, however, when masses of bone are found, sometimes serving for the attachment of teeth, sometimes separate; as well as other tissues, *e.g.* nervous tissue and striated muscle. Cysts with this variety of contents have been called *proliferative*. Dermoid, dentigerous, and proliferative cysts appear to be always congenital structures, but may show further growth and development in after-life. At least two-thirds of the known cases have occurred in the ovaries. Next to these organs, the testicles are the most frequent seat, but these cysts have been also found in other parts of the body-cavity, in the mediastinum, lung, and even within the skull. The origin of these growths is extremely obscure; but it is desirable to reject entirely the hypothesis that a mixed tumour of this kind can be the remains of an undeveloped fœtus included in the perfect individual; a hypothesis rendered improbable by the extreme irregularity of the tissues produced, the teeth, for instance, sometimes numbering one hundred or more. It would rather appear as if a portion of embryonic tissue, from the upper and middle germinal

layers, became misplaced at an early period of development.

6. **Parasitic Cysts.**—Several parasitic animals infesting the human body may appear in an encysted form, and may resemble in appearance true pathological cysts. The commonest, the larval form of *Tænia echinococcus*, or *hydatid cyst*, is known by its laminated wall, and by containing a fluid which is not albuminous, but holds in solution sodium chloride. *Cysticercus cellulosæ* has a transparent wall and clear contents. The other encysted parasites are either very small, as *Trichina spiralis*, or unimportant.

Contents of Cysts.—The serous cysts and hygromata contain an albuminous fluid like that of serous cavities, which may hold enough fibrinogenous material to coagulate spontaneously Leucocytes may also be present. If inflammation be set up, the proportion of albumin and of leucocytes becomes greatly increased. In the fluid of mucous cysts mucin is contained; in that of colloid cysts, little-known substances which are allied to gelatin. Sebaceous cysts contain neutral fats—sometimes hard, sometimes fluid, and cholesterin. Both mucous and sebaceous products may harden into concretions, and even become calcareous. In renal cysts urea has been found; in biliary cysts, bile-pigment; and in general the products of special secretion may be found in cases of retention, at least in early stages, but if retention last too long, special secretion may cease. Various exceptional contents have been already enumerated. J. F. Payne.

D

DACTYLITIS (δάκτυλος, a finger).—A term meaning inflammation of the finger. It is applied to syphilis and struma of that organ, as in the terms dactylitis syphilitica, and dactylitis strumosa.

DANDRIFF, or Dandruff (from two Saxon words signifying *itchiness* and *foulness*).—Synon.: Furfur; Scurf of the Head.—Dandriff is met with in pityriasis, chronic eczema, and lepra vulgaris or psoriasis of the scalp.

DANDY FEVER.—A synonym for Dengue. *See* Dengue.

DARTRE (Fr.).—This term is the French equivalent of the word *tetter*, and is applied to a variety of cutaneous diseases, without strict limitation.

DAVOS, in North Engadine, Switzerland. A dry, cold, bracing, winter-climate. Altitude, 5,177 feet. Season, October to March. Winds, N.E. and S. *See* Climate, Treatment of Disease by.

DAY-BLINDNESS.—A disorder of vision, characterised by the patient being unable to see during the day: also called Nyctalopia. *See* Vision, Disorders of.

DEAFNESS.—Loss of the sense of hearing. *See* Ear, Diseases of, and Hearing, Disorders of.

DEATH, Modes of.—The proximate causes of death, whether resulting from natural decay, disease, or violence, may be reduced in ultimate analysis to two, namely, first, cessation of the circulation; and, second, cessation of respiration. On the continuance of these functions, and particularly of the former (if specialisation is possible where all are essential) life of the body as a whole, or of the individual tissues and organs, depends. These functions may cease from causes directly operating on their mechanism, but they may also be brought to a standstill by causes operating indirectly through the nerve-centres which regulate them. Hence it is usual, in accordance with Bichat's classification, to describe this as a third mode of death; so that we speak of death beginning at the *heart*, death beginning at the *lungs*, and death beginning at the *head*. This classification is convenient; for though death beginning at the head is, in reality, death from failure of the respiration or circulation, or of both, through paralysis of the vital nerve-centres, yet the affection of the nervous system is the primary fact, and the phenomena are sufficiently distinct and characteristic to require separate consideration. It must, however, always be borne in mind that, owing to the interdependence of all the vital functions, there is no such sharp line of demarcation, in reality, as we, for convenience' sake, make in theory between the various modes of death.

I. **Death from failure of the Circulation.**—This may be (1) sudden, as in *syncope* and *shock*; or (2) gradual, as in *asthenia*.

(1) *Sudden failure of the Circulation.*—As the circulation of the blood depends on the difference in the pressure in the arteries and veins, the circulation will be brought to a standstill by any cause which annihilates, or very greatly lowers, this differential pressure. The cause may be in the heart, or in the vessels, or in both.

(*a*) In the *heart*. As the action of the heart is the chief factor in the maintenance of arterial tension, any organic or structural disease of the heart, rendering it incapable of propelling its contents into the arterial system, will naturally result in cessation of the circulation and death. Under this general head are to be classed all diseases of the heart and its annexes

But apart from structural disease, the heart may suddenly be made to cease through nervous

influence. The heart may be inhibited, or be made to cease finally and for ever either by central causes, such as violent emotion, or a blow on the head; or by reflex inhibition, as in the case of a violent blow on the epigastrium, or sudden irritation of the sensory nerves of the stomach, as in corrosive poisoning, and even in the ingestion of a large draught of cold water when the system is overheated.

Death from sudden cessation of the heart's action is death from *syncope*. Momentary cessation of the heart's action is transient syncope or fainting. There is sudden loss of consciousness, due mainly to the cessation of pressure in, and anæmia of the cerebral centres.

(*b*) In the *vessels*. Rapid fall of the blood-pressure, and cessation of the circulation, will naturally be brought about by rupture of the vessels, either from injury or disease, causing death by hæmorrhage. But besides actual rupture of the vessels, the vascular area may in certain conditions become so enlarged or dilated that we may practically have death from hæmorrhage without any loss of blood externally. This is what we observe in death from *shock* or *collapse*. In certain conditions, such as that resulting from blows on the abdomen, the vascular area of the abdomen and viscera may become so dilated as practically to retain almost the entire volume of blood in the body. Hence, even though the heart may be acting, yet the circulation throughout the body generally, and especially in the extremities and superficially, is practically *nil*.

The individual may, however, retain his consciousness, and thus he differs from a patient in a state of syncope. But very frequently in cases of blows on the abdomen, there is not merely reflex dilatation of the abdominal vessels, but also reflex inhibition, for a time at least, of the heart, so that we have syncope and shock co-existing. But the symptoms of syncope may pass off, leaving those of shock still remaining. Shock, like syncope, may be transient or fatal.

(2) *Gradual failure of the Circulation.*—This constitutes death from *asthenia*. This is the natural termination of life, and it is also the mode of death after wasting and exhausting diseases, cold, starvation, &c. The vital powers fade gradually, while consciousness may be retained up to the last moment.

II. **Death from failure of the Respiration.**—The various ways in which the function of respiration may be interrupted, and the phenomena consequent thereon, have been described under the head of Asphyxia, to which article reference may be made.

III. **Death from paralysis of the vital nerve-centres—Coma.**—As already remarked, death beginning at the head ends by paralysing respiration and circulation. The nerve-centres situated above the medulla and pons are not essential to life except in so far as animal life is concerned, and the possibility of adaptation to surroundings. Diseases of the brain, however, are liable to prove fatal by indirect action on the medulla and pons through pressure, extension of inflammation, and the like. Certain poisons also, whether introduced from without, —such as opium and narcotics generally,—or arising within, owing to the non-elimination of waste products, as in uræmia, affect the nerve-centres, both cerebral and spinal, and not only produce unconsciousness or coma, but also paralyse the respiratory and cardiac centres.

In death arising in this manner, the individual lies unconscious, reflex action becomes abolished, and the breathing becomes stertorous and ultimately ceases, death occurring quietly or in convulsions. In death from coma, in addition to the usual phenomena of asphyxia, there is, as a rule, more or less marked congestion of the cerebral and spinal centres. D. Ferrier.

DEATH, Signs of.—It is not always easy to determine when the spark of life has become finally extinguished. From the fear of being buried alive, which prevails more abroad than in this country, some infallible criterion of death, capable of being applied by unskilled persons, has been considered a desideratum, and valuable prizes have been offered for such a discovery. The conditions most resembling actual death are syncope, asphyxia, and trance, particularly the last. We cannot, however, say that any infallible criterion applicable by the vulgar has been discovered, and we do not rely exclusively on any one sign, but combine several.

The most reliable sign of death is proof of *cessation of the heart's action*. This, however, is not to be inferred from mere pulselessness, for the heart may still be beating, and resuscitation may be possible, when no pulse is to be felt in the arteries by ordinary manipulation. The use of the stethoscope is necessary, implying, of course, technical skill. Though, according to Rayer, the heart cannot cease to beat for more than seven seconds without death, yet, considering the very slow and feeble action of the heart (8 to 10 beats per minute) in hybernating animals, which normally have a pulse of 80 to 90 per minute, it is well to regard a similar condition as possible in man, and to spend in doubtful cases some minutes, up to half an hour, in auscultation. The so-called cases of life continuing notwithstanding cessation of the circulation, as that of Colonel Townsend, or of the Indian Fakirs, are to be set down as altogether apocryphal, and not scientifically investigated.

To enable unskilled persons to determine whether the circulation continues or not, Magnus recommends the application of a tight ligature on a finger or toe. If the circulation has quite ceased, no change in colour is produced; but if circulation continues, however feebly, the extremity, in course of a longer or shorter period, assumes a livid tint from strangulation of the venous flow, while a ring of arterial anæmia is observable at the point ligatured.

Cessation of the heart's action, if absolutely established, renders other indications unnecessary. As accessories they are useful, but the following signs are none of them individually conclusive taken alone. The first is *cessation of respiration*. Respiration may not be very obvious, and yet it may be going on. The popular methods of holding a cold mirror before the mouth and nostrils, and looking for indications of moisture; placing a flock of cotton wool on the lips to ascertain whether air-currents exist;

and placing a cup of water on the chest, and observing whether the reflection on its surface moves or remains still, are all well adapted for the purpose in view.

With the cessation of the circulation and vital turgor, the skin becomes ashy pale, and the tissues lose their elasticity. The eyeball becomes less tense, and the cornea becomes opaque. The pupils cease to react to light; and there is no vital reaction on the application of irritants to the skin. Though the body is dead as a whole, certain parts may continue to retain their independent vitality after somatic death. This is seen in the muscles, which may retain their electrical contractility from two to three hours after death. The existence of electrical contractility of the muscles in a body supposed to be dead indicates life, or death within two or three hours, according to M. Rosenthal.

The subsequent changes which occur in the dead body not only indicate the fact of death, but aid in fixing the probable period at which death occurred. These are the following:—

(1) *The cooling of the body.*—The body after death, except under certain special circumstances, as in fatal cases of cholera and yellow fever, ceases to be a source of heat-production, and therefore is to be looked upon as an inert mass possessed of a higher temperature than the average medium, which parts with its heat according to certain physical laws. The superficial coldness of collapse, which is due to cessation of the peripheral circulation, must not be mistaken for the cadaveric coldness, for there is still an amount of internal heat which has to be parted with, and the body, cold to the touch before death, may after death rise in temperature, as the internal heat radiates. It is impossible to describe here in detail all the circumstances which modify the rate of cooling of the body, but it may be said in general that all circumstances which favour radiation, convection, and conduction of heat in inorganic bodies are equally applicable here, while the opposite conditions retard. Therefore a thick coating of adipose tissue, clothing, &c., retard cooling. The exact thermometric observations of Drs. Wilks and Taylor show that at an average temperature, and without clothing, a dead body cools at the rate of about 1° Fahr. per hour.

(2) *Hypostasis.*—After death the blood gravitates to the most dependent parts, both externally and internally, giving rise to livid discolourations, termed *hypostases.* These are liable to be confounded with ecchymoses or extravasations externally, and with the results of congestion and inflammation in the internal viscera. They differ from ecchymoses in the fact that the blood is not extravasated into the tissues, but still contained in the vessels, as may be shown by an incision into the skin. So long as the blood remains fluid, these discolourations may be caused to disappear if the position of the body be reversed; they will again form in the parts which are now the most dependent. They usually occur in from eight to ten hours after death.

(3) *Rigor mortis.*—After death the muscles become stiff, giving rise to *rigor mortis* or cadaveric rigidity. It is due to coagulation of the muscle-plasma. This rigidity attacks the muscles usually in a certain definite order, beginning in the muscles of the neck and face, and gradually extending from above downwards. It gives way to putrefaction in the same order, so that while the upper parts of the body may be flaccid, the legs may be found rigid. It can only be overcome by tearing the tissues, and if overcome it does not return. In this it differs from cataleptic rigidity. A certain amount of mobility is still observable at the joints. In this it is unlike the stiffness of freezing, in which all the parts are equally rigid, and crackle if bent.

The period of the occurrence of rigidity, and the length of its endurance, are extremely variable, so that no definite practical rules can be laid down. It may be said generally, however, that the greater the store of muscular energy at the time of death, the longer it is before rigidity sets in, and the longer it lasts. On the contrary, the greater the exhaustion, the sooner rigidity sets in, and the sooner it disappears. Hence rigidity is longer in appearing in subjects dying suddenly in full muscular vigour, than in those dying from exhaustion. As a rule, a period of relaxation intervenes between death and the occurrence of rigidity, but in certain cases the last muscular contraction seems to pass directly into the rigidity of death. This is seen more particularly in death during great nervous excitement, as in soldiers in the field of battle, or in suicides. The same is said to occur also in death from strychnia-poisoning and in death by lightning.

Rigidity may therefore occur immediately on death or within a few hours. It has never been observed to be delayed beyond a day after death. It may last from so short a time as scarcely to be perceptible, up to a week or more.

(4) *Putrefaction.*—After death the tissues undergo changes in colour, consistence, &c., by which they are ultimately resolved into their simple elements, included under the general term *putrefaction.* Putrefaction, however, may occur locally during life, and general septic changes may occur to some extent before death. The term, however, is not generally applied until the changes are clearly perceptible in alteration of colour, consistence, and smell. The first external sign is a greenish discolouration of the abdomen. Internally the mucous membrane of the larynx and trachea is the first to exhibit change in colour and consistence. The less compact tissues putrefy first, the fibrous tissues resist longer, and the compact tissue of the uterus resists longest of all. In process of time, however, the soft tissues become entirely disintegrated and the skeleton is exposed and gradually falls to pieces.

The rate of putrefaction is very variable, depending partly on the state of the body itself, but mainly on external conditions as to temperature, moisture, and exposure. A combination of high temperature, moisture, and free exposure, are the most favourable conditions for rapid putrefaction. A high temperature alone without moisture tends to dry the tissues, and thus to produce mummification, instead of colliquative putrefaction. Moisture alone, as when a body lies in water or moist earth, tends to produce a saponification of the tissues, more particularly the fatty, with the

formation of a substance termed adipocere (*see* ADIPOCERE). The course of putrefaction can be stopped by antiseptics, as in embalming, and in certain cases of poisoning, as with arsenic, as also by freezing. Putrefaction is more rapid in air than in water, and least rapid in earth. Under ordinary circumstances and average temperatures, signs of putrefaction are clearly visible on the third day after death, commencing with the green hue of the abdomen. Many months elapse before the soft tissues become entirely disintegrated. The uterus has been found fit for judicial examination as long as nine months after death, where no antiseptics had been employed. When such has been the case, however, there is practically no limit to the period of preservation—witness the Egyptian mummies.

There is still much to be learnt respecting putrefaction, and it is unsafe to lay down dogmatic rules as to how far putrefactive changes shall have advanced at a given time, for even under apparently similar conditions the most extraordinary divergences have been recorded.

D. FERRIER.

DEBILITY (*debilis*, feeble). SYNON.: Feebleness; Weakness; Asthenia; Fr. *Faiblesse*; Ger. *Schwäche*.

DEFINITION.—The body or any of its organs are said to be in a state of debility when their vital functions are discharged with less than the normal vigour, being reduced in the amount of activity that they display, and of work that they can accomplish. The term debility is also employed in a somewhat different sense in the case of constitutional weakness of an organ, to convey the notion of vulnerability or predisposition to disease. In this acceptation, 'pulmonary debility,' for example, signifies a peculiarly delicate 'build' of the lungs, which renders them more than ordinarily liable to succumb to the causes of disease.

ÆTIOLOGY.—Debility is frequently constitutional and inherited; but it is more often developed after birth. It is most commonly due to impaired nutrition, whether this be prolonged and moderate, as in defective hygiene or chronic illness, or, on the other hand, rapid and extreme, as in acute disease. Another frequent cause of debility is abuse of the affected organ. Overuse of any part leads to fatigue, and if frequently repeated to exhaustion, the chief feature of which is extreme debility, as in cases of sustained mental exertion or of repeated strain of the heart. On the contrary, an organ may become feeble from want of exercise. Paralysed muscles furnish the best examples of this condition, but the same may be seen in all organs after unnatural rest.

SYMPTOMS.—The natural ability of the organs to perform their functions varies extremely with sex, age, previous exercise, and many other circumstances. Debility, or the loss of this functional power, is therefore frequently ill-defined; and, when unquestionably present, may vary greatly in different cases, from a condition in which fatigue comes on only somewhat earlier than usual, as in muscular debility, to a state in which the slightest exertion may exhaust the whole of the vital energy and the functional life of the part may cease—as is seen in the cardiac asthenia of acute fevers, and less markedly in certain chronic diseases, such as idiopathic anæmia and Addison's Disease.

Debility may be *general*, affecting the whole body; or *local*, individual organs only being involved. Speaking generally, the symptoms of debility of an organ may be said to be chiefly two. These are, first, increased irritability, or an unnatural readiness of the part to respond to stimulation; and, secondly, a tendency to untimely exhaustion. The phenomena of irritability and exhaustion naturally vary with the organ involved. The symptoms of muscular asthenia are few and simple; those of digestive feebleness are more complex; and in debility of the nervous system the whole of the mental processes, as well as the functions of organic life, may be involved. For a specific account of the phenomena of each of these cases, and of debility of other parts, the reader is referred to the articles upon diseases of the several organs.

DIAGNOSIS.—Debility pure and simple is as a rule easily distinguished from *disease* by the absence of all evidence of organic alteration, and especially of physical signs of anatomical change. It is more difficult to separate debility from *disorder* or *derangement*, but careful observation will generally determine in the case of pure debility that the functions are normally discharged as long as the demands made upon them are not excessive.

PROGNOSIS.—Debility due to acute disease may, in the absence of complications, be expected to disappear during convalescence. If the cause have been more chronic, and be less easily removed, recovery will certainly be more slow and less satisfactory. The prognosis of inherited constitutional debility, as regards its disappearance, is nearly always unfavourable.

TREATMENT.—Debility must be treated according to its cause. If nutrition have failed, it must be restored as far as possible; and until this can be done, stimulants and suitable tonics are indicated—especially in the case of acute disease. Rest is of the first importance in most instances; and it is frequently alone sufficient to restore the vital force. In a few cases, however, the opposite line of treatment must be followed, as in muscular debility from indolence or in some forms of paralysis. Where the vital activity is low from constitutional defect, age, or sex, the condition may not be remediable; and the treatment of such cases is chiefly prophylactic. The principal indication then is to secure the subject of debility against exposure to damaging influences.

J. MITCHELL BRUCE.

DECLINE (*declino*, I decline).—A popular name for any wasting disease; it is especially associated with pulmonary consumption. The word is also applied to the period in the course of a disease when the symptoms are abating; and likewise to the time of life when the physical and mental powers are failing.

DECUBITUS (*de*, down, and *cumbo*, I lie).—The lying posture. *See* POSTURE.

DEFÆCATION, Disorders of.—On the descent of the fæces, which accumulate in the sigmoid flexure of the colon, into the rectum, the associated movements necessary for their expulsion are excited. These movements are chiefly involuntary, though influenced and controlled by the will.

Some of the more important difficulties interfering with the actions of defæcation arise from disorders in the *nervous system*, by which the movements are excited and directed. In injuries and diseases of the brain or cord, the control of volition, especially its influence over the sphincters, is annihilated, whilst the excito-motory movements depending on the spinal cord continue. In these cases the actions of defæcation take place only when the need of expulsion arises without any power of the patient to induce or restrain them. In injuries destroying the lower part of the spinal cord, the fæces escape involuntarily in varying quantities and at all times.

Serious troubles in defæcation may also arise from excessive as well as from weakened action of the *muscles* concerned in this function. The sphincter may be irritable or subject to spasm, and resist too forcibly the expulsive actions of defæcation (*see* ANUS, Diseases of); or the muscular fibres of the rectum may lose their tone, be defective in power, and incapable of properly extruding the fæces. Patients thus situated are often obliged, when at stool, to use the finger to dislodge masses retained in the weakened bowel. An atonic condition of the rectum usually arises from over-distension. It may be produced by too free and frequent use of enemata, the quantity injected being so large as to dilate the bowel and impair the power of its muscular coat. This atonic state of the bowel is apt to give rise to fæcal accumulations. Cases of this kind are not uncommon, yet the nature of the affection is liable to be overlooked. The rectum may become gradually dilated and blocked up by a collection of hard dry fæces, which the patient has not the power to expel, being unable from loss of tone in the distended bowel to overcome the resistance of the sphincter to the passage of so great a body. Some indurated lumps from the sacs of the colon, on reaching the rectum, perhaps coalesce so as to form a large mass; or a quantity accumulated in the sigmoid flexure, on descending into the lower bowel, becomes impacted there. In several instances a plum-stone has been found in the centre of the mass. Such a collection gives rise to considerable distress, producing constipation, a sensation of weight and fulness in the rectum, tenesmus, and forcing pains which women liken to those of labour. In cases of some duration, where the hardened fæces do not quite obstruct the passage, they excite irritation and a mucous discharge, which, mixing with recent feculent matter passing over the lump, causes the case to be mistaken for diarrhœa. Injections have no effect in softening the indurated mass: they act only on the surface, and return immediately, there being no room for their lodgment in the bowel. The practitioner on passing his finger finds the rectum blocked up with a large lump, which feels almost as hard as a stone. In such cases the only mode of giving relief is by mechanical interference. The mass requires to be broken up and scooped out. After the breaking up and extraction of the larger portions, injections of soap and water will be sufficient for the removal of the remainder. The persons most subject to these troubles are those enfeebled by age or disease, especially women. They may also occur in infants who have been operated on for imperforate anus, when the artificial aperture contracts or is left too small for the free passage of the fæces. In these cases the distension of the bowel is sometimes excessive, and its expulsive functions are seriously impaired and weakened. *See* FÆCES and CONSTIPATION. T. B. CURLING.

DEFERVESCENCE (*de*, down, and *fervesco*, I grow hot).—The decline of fever, characterised by a fall of temperature and of pulse, and by other phenomena. *See* FEVER.

DEFORMITIES.—*See* MALFORMATIONS.

DEFORMITIES OF THE CHEST.—Under this head are included all deviations in shape from the normal chest.

Deviations from the shape of the typical thorax are appreciable by careful physical examination. Of the various methods employed for this purpose, by far the most valuable are inspection and mensuration. Although in some few cases it may be important to determine the exact amount of deformity by mensuration, there are very few deviations in shape or size of the thorax, the degree of which cannot be sufficiently estimated for clinical purposes by the eye and hand, without the aid of any special instruments for measuring.

Deformities of the chest may be due either to abnormity of the parietes; or to disease of internal structures.

DESCRIPTION.—Deviations from the form or size of the typical thorax may be either *general* or *local*; *i.e.* the abnormity may involve the whole thorax, or a part only.

I. General Deformities.—1. *General Diminution.*—The chest may be too small—that is, diminished in all its diameters without being in other respects deformed. Diminution of the thorax simultaneously and uniformly in its antero-posterior and lateral diameters is effected mechanically by an increase in the obliquity of the ribs. The smaller the chest (having regard to the height of the person) the more obliquely are the ribs arranged, and the more acute the angle formed between each of the true ribs (excepting the first) and its cartilage. The intercostal spaces of the true ribs are widened about the junction of the ribs with their cartilages, and at the same time the ribs posteriorly are approximated more closely to each other, the closeness of the approximation being in proportion to the diminution in the size of the thorax. The vertical diameter of the thorax is lessened by an increase in the height of the arch of the diaphragm. The very oblique position of the false ribs, and the height to which the diaphragm rises into the chest, cause several of the false ribs to lie in contact with the diaphragm, and thus no portion of lung is under these ribs. They are, practically speaking, no longer part of the chest-walls.

The costal angles are diminished in proportion

to the diminution of the size of the thorax, *i.e.* to the obliquity of the ribs. The obliquity of the ribs also causes the shoulders and the sternal ends of the clavicles to droop, and at the same time to incline forwards; the upper part of the scapula is carried by the shoulder forward, the inferior tilted backward. General and symmetrical diminution in the size of the thorax has one and only one cause, namely, small size of the lungs. Small lungs may be congenital, *i.e.* due to original conformation; or the consequence of atrophic degenerative changes incident to age. In both these cases the lungs are, in relation to the length of the ribs, disproportionately small, and as a necessary consequence, the relatively too long ribs are arranged more obliquely than they are in a well-formed chest, and the diaphragm is pushed by the abdominal organs higher into the thorax. When the small size of the lungs is due to atrophy, the supra-clavicular fossæ are deepened and the vertical diameter of the chest proportionately diminished. In advanced life the congenitally small lungs are frequently reduced still further in size by the supervention of atrophous emphysema. The congenitally small lungs and the consequently small chest is one of the characteristics of tuberculosis, *i.e.* of that congenital organization in which tubercle is likely in subsequent periods of life to occur. Atrophous emphysema is especially common in those who have either manifested symptoms of tubercle in their youth, or belong to tubercular families. It is the congenitally small lungs of childhood which are prone to become the seat of tubercle in youth, and the subjects of atrophous emphysema in old age.

2. *General Enlargement.*—The thorax may be too large, increased in all its diameters, without being otherwise deformed. It is simply bigger than it should be, having regard to the height of the subject.

When the thorax is abnormally large, the ribs, instead of being more obliquely situated than natural, as they are in the small thorax, are placed more horizontally than they are in the normal thorax. The angle formed between each rib and its cartilage is greater than in health; while the intercostal spaces, especially the lower, are widened, and the ribs less closely approximated, the arch of the diaphragm is lessened in depth, and a considerable mass of lung lies under the lower false ribs, between them and the diaphragm. The chest is increased in all its diameters. The shoulders are raised. The costal angles are greater than natural.

Increase in the size of the whole thorax has but one cause, viz., increase in the size of the lungs. Increase in the size of the lungs generally, and pretty uniformly, is the consequence of disease, and of one disease only, viz., large-lunged or hypertrophous emphysema. When the increase in size of the thorax attending large-lunged or hypertrophous emphysema is moderate in degree, the increase in its size is effected by the altered position of the ribs; but when the lung-disease is extreme, then a certain amount of the enlargement is caused by pressure on the inside of the chest during the violent expiratory efforts of severe cough.

3. *Irregular General Deformities.*—In the deformities above described the antero-posterior and the lateral diameters retain more or less perfectly their normal proportion—both are increased or both are diminished; in the former case the chest is on the whole more barrel-shaped than natural, but the deviation from the normal form is not considerable. If, however, the chest-walls are from any cause unduly soft or unduly rigid, then the actually or relatively soft portions will recede during each inspiratory act, and local deformity of the chest follows. The diameter of the chest at the part where the absolutely or relatively soft portion of the parietes is placed will be diminished. The special deformities of the chest which result are due, therefore, primarily to the state of the parietes, and are not, as those previously described, secondary to conditions of the lungs themselves.

a. Diminution in the antero-posterior diameter of the thorax.—The antero-posterior diameter of the thorax is frequently less than that of the normal thorax, the lateral diameter being proportionately increased. The chest has an oval form—it is flattened from before backwards.

The thorax flattened from before backwards is usually associated with small lungs, but the mechanical cause of the flattened form is the want of full resisting power in the ribs and considerable strength in the cartilages. These conditions of thorax are common in the subjects of tuberculosis.

The flattening of the thorax is increased by all impediments to the free passage of air through the air-tubes. In some children suffering from even slight bronchial catarrh, the flattening of the chest is seen to be increased at each inspiration; and if the impediment to the entrance of the air to the pulmonary tissue be constant or extreme, not only is the flattening increased at each inspiration, but the sternum is also depressed, especially at its lower half below the level of the costal cartilages, and thus the antero-posterior diameter of the thorax is still further diminished in the median line.

b. Increase in the antero-posterior diameter of the thorax.—In rickets the cartilages of the ribs are very firm, whilst the ribs themselves are softer than natural, and especially so near to their enlarged growing ends—the softest part of the ribs; that is to say, just outside the nodule formed at the spot where cartilage is in the process of growing into bone. The consequence of the extreme softness of the ribs at this part is that at each inspiration the weight of the atmosphere presses inward the softest part of the ribs, while the sternum is borne forward by the firm cartilages. The result is great increase in the antero-posterior diameter of the thorax, and diminution of the lateral diameter at the part corresponding to the softest part of the ribs. The depression of the softest part of each rib is increased by the want of resilience of the softened structures.

A groove is thus formed in the thoracic walls just posterior to the rickety nodules; and this groove being deepened at each inspiration, the part of the lung adjacent is compressed in place of being expanded during the inspiratory act. At the same time, in consequence of the cartilages and sternum being thrust forward at

each inspiration, air enters with undue force into the lung-tissue subjacent to these parts. The consequence of the excessive expansion of the anterior part of the lung is vesicular emphysema, and the recession during inspiration of the softened and imperfectly resilient and therefore deeply grooved part of the chest-wall leads to collapse of the subjacent pulmonary tissue; and, as the effect of these two conditions, the lungs, when the chest is opened, present a vertical groove corresponding to the groove in the chest-walls. The antero-posterior diameter of the thorax in rickets is still further increased by the curvation of the spine. The muscles are weak, the child is unable to sit upright, that is to say it is unable, in consequence of the weakness of its muscles, to support the weight of the upper part of its body, the bones of the spine are, in common with the other bones of the body, softened, and the result of the weakness of the muscles and the softness of the vertebræ is the dorsal bow.

When deformity of the chest is the result of undue softness of the chest-walls, the position of the solid organs subjacent to the parietes is frequently perceptible to the eye. The liver supports the lower ribs on the right side, the heart supports the ribs and cartilages over it on the left side, and thus these organs cause local prominence of the chest-walls without being themselves in any way abnormal.

In the so-called *pigeon-breast*, the antero-posterior diameter of the thorax is increased in the middle line, the lungs are small, the ribs and cartilages are firm, the ribs are placed obliquely and the chest-walls are flattened laterally, and the sternum as a consequence is thrust forwards; thus the chest in the pigeon-breasted has a triangular form, the apex of the triangle being the sternum. Impediment to the free entrance of air into the lower lobes of the lungs will favour the production of and increase the deformity. The chests of children who suffer from repeated attacks of bronchitis, but are otherwise healthy, are commonly the subjects of this deformity, while there is increased expansion and subsequent enlargement of the upper part of the chest, the lungs being more or less collapsed below and emphysematous above.

c. Transverse anterior constriction of the lower part of the thorax is the consequence of small size of the lung, or of imperfect inspiratory expansion, permanent or frequently recurring in youth. In these cases the lower ribs are little used in respiration, while below they are borne outwards or supported by the liver, stomach, and spleen, and thus an imperfectly formed transverse depression is produced in the front of the chest on a level with the base of the ensiform cartilage.

The deviations from the type of the normal thorax hitherto described are bilateral, and more or less symmetrical.

II.—**Local, unsymmetrical, and unilateral deformities.**—1. *Fulness of the supraclavicular region.*—The supraclavicular region, corresponding to the portion of the thoracic cavity above the clavicle, may be fuller than natural. The causes of this local bulging are—*a.* Development of adipose and cellular tissue. *b.* Distension of the deep-seated veins. *c.* Large-lung emphysema, in which disease there is occasionally distension of that part of the cavity of the thorax which lies above the level of the clavicle; the distension is due to pressure on the inside of this part of the thoracic cavity; air being forced violently into this part of the lung during the powerful expiratory effort of cough.

2. *Depression of one supraclavicular fossa* is caused by any pathological condition of the apex of the lung which produces diminution of its bulk, *e.g.* atrophous emphysema, or chronic consolidation of the apex.

3. *Elevation of one shoulder.*—Occupation is a common cause of elevation of one shoulder; thus in clerks, who sit much at the desk, the left shoulder is permanently a little higher than the right, and the upper portion of the spine is slightly curved, the convexity being to the left; so in those who carry heavy weights on one arm, the opposite shoulder is elevated and the spine curved. Whatever necessitates an increase in the capacity of one side of the thorax causes elevation of the shoulder on the same side: thus, considerable dilatation of the heart, fluid in the pericardium, fluid in the pleura, aneurism of the arch of the aorta or of the innominate, all lead to elevation of the shoulder. The shoulder is depressed and carried forward when, from any cause, the whole or upper part of one side of the chest is diminished in size, *e.g.* when the apex of the lung is the seat of chronic pneumonia or chronic phthisis.

4. *Uniform dilatation of one side* of the thorax is due, with one exception, to fluid or air in the pleura; the exception is those rare cases of encephaloid cancer of the lung, in which the formation of cancer is uniformly diffused through the lung-tissue, and in amount so great that the lung 'infiltrated' with cancer very decidedly exceeds in bulk the healthy lung inflated with air by inspiration.

In uniform dilatation of one side of the thorax, the shoulder is raised, the ribs are placed more horizontally than on the healthy side, the intercostal spaces are widened, and the spine slightly curved. When the enlargement is moderate in amount, the increase in capacity is effected by the altered position of the ribs; but when the increase in size is very considerable, then it is due in part to the pressure exercised by the air, fluid, or cancer-loaded lung on the inner side of the chest-wall.

5. *Uniform contraction of one side* of the thorax is the consequence of any pathological condition which leads to general and uniform reduction in the size of the lung, *e.g.* cirrhosis of the lung, infiltrated cancer of the lung, chronic tubercular disease of the lung, chronic pneumonia, or the change in the texture of the lung which follows long-continued compression by fluid in the pleura. When the whole of one side of the thorax is reduced in size, the shoulder on that side is depressed, the ribs are placed more obliquely and are more closely approximated than on the opposite side, the intercostal spaces are narrowed, and the spine is curved, often considerably, the concavity of the curve being towards the contracted side.

6. *Lateral curvature of the spine*, instead of being the consequence, may be the cause of deformity of the thorax: the ribs are then approximated on the side and at the part where the concavity of the curvature is placed, while they are separated and the shoulder raised on the side of the convexity.

7. In *angular curvature of the spine* the deformity of the thorax varies with the seat and the extent of the vertebral disease; but, speaking generally, it may be said that in angular curvature of the spine the antero-posterior diameter of the thorax is increased in proportion to the amount of destruction of the bodies of the vertebræ, and that the ribs are in a corresponding degree approximated.

8. *Extreme depression of the lower part of the sternum* is the consequence of softness of the cartilages of the ribs and impediment to the free passage of the air to the pulmonary tissue. This deformity is never congenital, although the subjects of it often affirm it to be so; it may, however, commence to be formed directly after birth if there be a congenital impediment to the entrance of air into the lungs, *e.g.* atelectasis.

This deformity may be the result of direct pressure. In certain occupations pressure has to be exerted on the lower part of the sternum—thus, some shoemakers use a wooden instrument which has to be kept in its place by pressure against the lower part of the sternum. For direct pressure to produce this deformity it must have been applied in early youth, while the parts are still flexible, and have been exerted frequently over a long period of time.

9. *Congenital deformities* of the thorax are few in number and are due to arrest of development—for example, cleft sternum, and defective formation of one or more ribs or cartilages.

10. *Unsymmetrical diminution in size of a part* of the thorax is produced by any pathological change which reduces the size of the subjacent part of the lung. All chronic inflammatory or congestive conditions of the apex of the lung, whether primary or the consequence or the concomitant of the formation of tubercle, are attended by diminution of the bulk of the part of the lung which is the seat of the lesion. Considerable loss of pulmonary tissue is usually accompanied by falling inwards of the chest-wall over the cavity.[1] The formation of a cavity is almost invariably attended by chronic inflammatory condensation, and this increases the local depression of the chest-wall. In chronic thickening of the pleura, the chest-wall at the part is, by the contraction of the fibrin, drawn inwards, and the lung subjacent to the thickened pleura being condensed, the chest-wall is also forced in during inspiration by atmospheric pressure. Hence, after pleurisy limited in extent it is common to find permanent flattening of the thoracic parietes at the base of the chest on the side affected.

In cancerous infiltration of the lung, limited in extent, the lung-tissue is sometimes so much condensed that the bulk of the cancer and lung are less than that of the healthy lung, and the chest-walls as a consequence are flattened over the seat of disease.

11. *Unsymmetrical localised bulging.* If the ribs are, in relation to the size of the lungs, disproportionately long, and their cartilages soft, then one or more of the cartilages may be knuckled forwards; the cartilage, being compressed between the end of the rib and the sternum, bends in an angle outwards. Although the prominence is trifling, it often causes anxiety to parents and its subject. Local deformity of this kind is occasionally the result of repeated lateral compression of the chest-wall in the athletic sports of young boys, *e.g.* cricket.

All the diseases of the chest which are accompanied by general enlargement of both or one side of the chest, when localised, are attended by local bulging; thus a common cause of abnormal fulness of the lower part of the left side of the thorax, posteriorly, is emphysema of the corresponding part of the lung; a moderate amount of fluid in the pleura is attended by fulness of the lower part of the chest on the same side. In both these cases the ribs are raised into an abnormally horizontal position; the chest-walls are not pushed outwards, but the ribs are raised, and the intercostal spaces are to that extent widened. The ribs are put into the position which gives the greatest capacity to the thoracic cavities containing the fluid or the enlarged lung. Local bulging may be produced by aneurism of the arch of the aorta or of the innominate artery; by growths, malignant or other, within the chest; by chronic pleurisy with effusion circumscribed by dense false membrane; by hydatids; or by abscess; and in all these cases the prominence is due to direct pressure on the inner side of the chest-wall, and to changes in the chest-wall itself.

Hypertrophy and dilatation of the heart, and fluid in the pericardium are attended by fulness of the præcordial region. The bulging from these diseases is much greater in the child than in the adult. In these cases a little of the fulness is produced by a more horizontal arrangement of the ribs; but when the prominence of the præcordial region is at all considerable, it is the result of the pressure exercised by the fluid or by the large and powerfully acting heart on the inner surface of the corresponding part of the chest-wall.

At the part corresponding to the junction of the first and second bones of the sternum, opposite the cartilage of the second rib, the sternum projects forward. This prominence is called the angle of Ludovicus. Any impediment to the free entrance of air into the lungs may cause depression of the lower part of the sternum; if the ossification of the sternum is not complete at the junction of the first and second bones, undue prominence of this part is the result. Subsequently a formation of bone takes place at this spot, and increases the prominence.

WILLIAM JENNER.

[1] It is said that a very large air-containing cavity may give rise to local bulging.

DEGENERATION (*degener*, unlike one's race; out of kind).

DEFINITION.—The word 'degeneration,' meaning etymologically change or deterioration of kind, is used in pathology for any process by

which a tissue or substance becomes replaced by some other, regarded as less highly organised, less complex in composition, of inferior physiological rank, or less suited for the performance of its original functions. While some change for the worse is thus the essence of degeneration, it is of secondary importance by what steps this change is effected. It may be by direct chemical *metamorphosis*, as of albuminous into fatty material; by *infiltration* of the tissues with some new material, as in albuminoid degeneration; or even by *substitution* of a newly-formed tissue, inferior to the original in organisation or in functional efficiency, as in what is called fibroid degeneration. Degeneration is very closely connected with atrophy, since on the one hand it is often caused by imperfect nourishment, and on the other hand may be a stage in progressive wasting; so that it may be difficult to draw the line between the two.

Summary.—The following kinds of degeneration may be recognised:—*Albuminoid*, *Fatty*, *Mucoid* or *Colloid*, *Parenchymatous*, *Calcareous*, *Pigmentary*, and *Fibroid*, with possibly one or two minor varieties of less moment. The two first-mentioned are described elsewhere (*see* Albuminoid Disease, and Fatty Degeneration).

1. **Mucoid or Colloid** degeneration is in one sense a physiological process, since it is probably by a partial transformation of the protoplasm of epithelial cells into mucin that the secretion of mucus is effected.

Mucoid and colloid degeneration are sometimes distinguished. We are unable to recognise any difference except in situation, and this distinction is better expressed in other words. The process consists in the transformation of portions, usually albuminous, of the tissues into a semi-transparent homogeneous material, varying in consistency from fluid to a gelatinous solid, and consisting of altered albuminates with variable proportions of mucin, a substance allied to albumin, but differing in its entire insolubility in acetic acid, and solubility in alkalies. All masses of gelatinous appearance have not this composition, since the colloid material which fills some ovarian cysts, that of renal cysts, and probably that found in some other cases, is said to contain no mucin. The thyroid gland when enlarged and cystic, as in one form of bronchocele, is a striking instance of colloid degeneration. The enlarged cystic vesicles become filled with colloid material, which plainly results from a transformation of the epithelial elements, and possibly also of some albuminous exudation in the original vesicles. Small masses of colloid material first appear in the cells, which become confluent into homogeneous masses. In colloid cancer a similar process appears to take place, but is rather synchronous with, than subsequent to, the growth of the tumour. The alveolar spaces which in other forms of cancer are filled with cells, here contain colloid material resulting from the metamorphosis of cells, and every transitional stage, from the epithelioid cancer-cell to a homogeneous translucent mass, may often be met with. The stroma is unaffected, and remains fibrous. The gelatinous material of colloid cancer is stated to contain more mucin than that of the enlarged thyroid. It is instructive to notice that this form of cancer usually occurs or commences in parts where epithelium is present, which undergoes the mucous transformation and secretes mucus, as in the stomach and intestines. When colloid or mucoid transformation affects tissues of the connective tissue group, it is the intercellular substance which appears to be chiefly affected. This change is seen in the mucoid softening of cartilage which sometimes occurs in old age, where the chondrin undergoes chemical change, and the intercellular substance softens into a diffluent or liquid substance containing mucin. The so-called mucous tissue which forms the umbilical cord, and the vitreous body of the eye, as well as certain fœtal structures, consists essentially of a reticulated connective tissue with mucous intercellular substance, and the same tissue forms the new growth called myxoma, which may therefore be regarded as formed by mucous transformation of connective tissue. Its cells are quite unaffected by this change, being either fixed stellate connective tissue cells, or migratory lymphoid corpuscles. This view explains how portions of other tumours, as sarcoma, enchondroma, and lipoma, are often found to have undergone myxomatous degeneration. All these mucoid or colloid substances contain mucin with albuminates.

2. **Parenchymatous or Granular** degeneration, also called *cloudy swelling*, is a peculiar change met with in some epithelial structures, especially liver- and kidney-cells, and muscular tissue, occurring only in the course of some infective febrile diseases, especially typhus, enteric fever, scarlatina, diphtheria, pyæmia, etc. The histological elements are found after death to have lost their transparency, and to be filled with minute granules, so that the general appearance is not unlike that of fatty degeneration. The naked-eye appearance of the organs is also not dissimilar; they are pale, dull, and opaque-looking. This change has been thought to be the precursor of fatty change: but whether this be so or not, it is at once distinguished by the solubility of the granules in acetic acid, and their insolubility in ether. The cause of this degeneration has been asserted to be simply high temperature; still it is not found in all febrile diseases. It has also been regarded as a post-mortem change, which is possible, but still this implies some abnormality in the tissues during life.

Another change also occurring in febrile diseases is *waxy* or *vitreous* degeneration of the voluntary muscles. They are found after death with little or no striation, and the myosin irregularly coagulated in lumps. That this is a change occurring after death there can be no doubt; while it is equally clear that this abnormal coagulation shows some abnormality of composition to have existed during life.

3. **Calcareous** degeneration consists in the deposition of calcareous particles in the elements of a tissue, or in some inflammatory products previously formed. It is more appropriately called *calcareous infiltration* or *deposit*. When the normal tissues are thus infiltrated, there is not of necessity any other alteration in the tissues themselves, though the process generally indi-

tates retardation of the circulation or arrest of tissue-metamorphosis. In the case of inflammatory products, new-growths, and parasites, as well as in other cases, the calcareous deposit follows on partial necrosis or local death. It is, therefore, if not a degeneration, the consequence or accompaniment of degeneration. *See* DEPOSITS, Calcareous.

4. **Pigmentary** degeneration is a name which has been given to the changes produced in a tissue or organ by the deposition or formation of pigment. It is very doubtful whether this should always be described as a degeneration, since this change does not necessarily diminish the vital activity of the part, lower its physiological rank, or involve a simpler chemical or anatomical composition. Pigmented tumours do not show less vitality than others, nor is excessive pigmentation of the skin or any organ where pigment normally occurs, necessarily an accompaniment of degeneration. On the other hand, the pigmentation of the spleen and liver from intermittent fever, and that which is the consequence of chronic venous congestion, are often the accompaniment of fibroid induration, and thus form part of a degenerative process. Pigmentation in general must not, therefore, be identified with pigmentary degeneration.

5. **Fibroid** degeneration is the name given to a process in which the original tissue becomes replaced by a form of connective tissue. It is also called *fibroid substitution* or *fibroid change*. In the early stages of this process we find the tissues penetrated with numerous cells of the lymphoid type, which become slowly organised into connective tissue—at first of the cytogenous form, and rarely very vascular. The infiltrated lymphoid cells are probably chiefly derived from the blood-vessels; but some may be, as theory teaches, the descendants of tissue-cells. The process is essentially chronic interstitial inflammation (*see* INFLAMMATION). Since the final result of the process is that tissue of less physiological value is substituted for the original, the process may be described in general terms as a degeneration, though it is not an actual metamorphosis of tissue. It finally leads to induration, contraction, and partial atrophy.

J. F. PAYNE.

DEGLUTITION, Disorders of.—Before describing the disorders of deglutition or swallowing, it is necessary to state briefly in what this physiological act consists, and how the process is performed.

PHYSIOLOGY OF DEGLUTITION. — The act of deglutition is commonly divided into three stages. The first is a voluntary effort, accomplished by means of the tongue and the muscles of the cheeks and mouth, as far back as the anterior arch of the fauces. The second stage is an involuntary act, though certain voluntary muscles are engaged in effecting it; and it is accomplished by the action of those muscles whose duty it is to retract the tongue, to raise the larynx and close the glottis, to lift the soft palate, to contract the fauces and bring the tonsils in contact with the bolus of food, to close the posterior nares, and to raise and contract the pharynx. Then the food passes into the œsophagus or gullet, when the third stage is entered upon; and as the morsel passes into this tube, a progressive undulatory or peristaltic movement of the gullet is produced, by which the bolus is propelled into the stomach.

DEFINITION.—Any condition which interferes with the perfect integrity of this physiological process constitutes a disorder of deglutition. The general term which is commonly applied to this condition is Dysphagia or Deglutitio Impedita, as it is sometimes termed. But, in actual fact, such conditions will be found to be dependent for the most part on some other morbid state of the structures immediately concerned in the act of swallowing, or of those in close proximity to them. Yet, although dysphagia must, as a rule, be regarded merely as a symptom of some more or less serious disorder, still it may be convenient and useful to examine the subject somewhat more in detail than can be done in the consideration of those affections in which it frequently plays so prominent a part.

ÆTIOLOGY.—All affections of the throat modify in some way the power of swallowing, and render the act of deglutition painful and difficult. Thus:—1. We meet with it as one of the symptoms in acute catarrh of the pharynx, in tonsillitis, and in ulceration of the throat, which disturbances are dependent upon some alteration in the mucous membrane, the submucous cellular tissue, or the muscular tissue. 2. Similarly, diseases of the larynx may give rise to disorders of deglutition; such as laryngitis, inflammation of the perichondrium of the cartilages, and laryngeal polypi. 3. Specific diseases, for example, phthisis, syphilis, cancer, scarlatina, measles, and croup, are another fertile cause of difficulty of swallowing, owing to their affecting the throat in various ways. 4. So also are nervous affections, for instance, post-diphtheritic paralysis, hysterical affections, general paralysis of the insane, progressive muscular atrophy, and glosso-laryngeal paralysis. 5. Affections of the salivary glands, such as parotitis, may interfere with deglutition. 6. Œsophageal disorders, whether functional, or causing organic obstruction, are important causes of dysphagia. 7. Difficulty of deglutition may result from pressure upon some part of the passage, as by an aneurism of the thoracic aorta, a solid tumour, whether malignant or benign, or a retro-pharyngeal abscess. All these causes, though in different degree, offer some impediment to the act of deglutition.

SYMPTOMS.—Although difficulty in the act of swallowing is the essential symptom in many and various affections, yet this differs greatly in degree, as well as in the attendant phenomena, according to the pathological condition of the parts involved. Thus, when irritation of any kind is met with in any part of the track through which the bolus of food has to pass, then the act of deglutition is attended merely with more or less pain, which in such cases constitutes the sole difficulty in the process. When, however, the calibre of this portion of the alimentary canal is reduced by disease affecting its own structure, or when it is encroached upon by morbid growths or other disease in its immediate

vicinity, a mechanical impediment is set up, which necessitates a certain amount of voluntary effort to accomplish the act. This supplementary aid is usually sufficient to propel the bolus onwards, and deglutition, though slower than in health, and usually attended with pain, may be successfully performed. It occasionally happens, however, that the obstruction is so great as to prevent the passage of at least the larger portion of the food downwards, and regurgitation takes place through the mouth or nostrils.

A similar result is brought about when paralysis affects any portion of the muscular structures concerned in the act of swallowing, but obviously in a different manner. For example, in post-diphtheritic paralysis, in consequence of the implication of the soft palate and neighbouring structures in this loss of power, the food, instead of passing into the gullet, returns through the posterior nares.

The dysphagia occasionally observed in hysterical persons, and which appears to partake of the nature of spasm, differs essentially from those forms already described, in the fact that it is not a constant phenomenon.

In addition to those varieties of dysphagia dependent upon morbid conditions of the apparatus concerned in the act of swallowing, another kind may also be induced by the nature and form of the articles partaken of. Thus, irritant, corrosive, and very hot substances may readily give rise to difficulty in swallowing. In like manner dysphagia of an urgent character is often caused by the impaction of a large bolus of unmasticated food in the œsophagus.

Treatment.—This will manifestly depend upon the recognition of the cause which gives rise to the impediment in swallowing. Cases of simple catarrh of the mucous membrane of the throat, and those produced by the action of irritant substances generally, yield, after a short interval, to the use of bland articles of diet and demulcents. such as olive oil, milk, linseed tea, &c. It must, however, be borne in mind that permanent stricture of the œsophagus may be the result of causes such as those last mentioned. Of course, when abscess is the cause of the dysphagia, the evacuation of its contents will give immediate relief. In that form of dysphagia dependent upon diminution of the calibre of the œsophagus, the question of its treatment by the use of bougies or stomach-tubes should be considered. *See* Œsophagus, Diseases of.

The dysphagia dependent upon specific disorders of the larynx, such as that occasioned by phthisis, syphilis, cancer, &c., may often be greatly mitigated by the use of warm medicated sprays of a sedative character, such as bromide of ammonium, chlorine water, or other agents. In cases acknowledging a nervous origin, the treatment must bear reference to the general nervous disorder of which the dysphagia is but a symptom. Thus hysterical dysphagia may be speedily removed by the application of galvanism in the neighbourhood of the œsophagus. Post-diphtheritic dysphagia usually disappears as the health of the patient improves, and is to be treated by the administration of nervine tonics, such as strychnia, iron, and quinine.

C. Muirhead.

DELHI SORE OR BOIL.—Synon. Aleppo Evil; Mycosis Cutis Chronica (V. Carter); Lupus Endemicus (Lewis and Cunningham); Oriental Sore (Fox). Fr. *Bouton d'Alep*; Ger. *Beule von Alep*.

Definition.—An indurated, indolent, and very intractable sore; papular in the early, encrusted or fungating in the advanced stages; spreading by ulceration of skin; single or multiple; and often occupying extensive surfaces of the exposed parts of the body, such as the face, neck, and extremities. It is capable, if inoculated, of reproducing the disease; and it also affects dogs and horses.

Geographical Distribution.—This disease occurs in India, especially the North-west Provinces, Punjab, Cabul and Scinde, Persia, Arabia, Crete, the Sahara of Africa, perhaps China, and doubtless wherever certain peculiar conditions of soil and hot climate co-exist. Though called Delhi boil, it is neither a furunculus, nor is it peculiar to that city. The Scinde boil, the sores of Roorkie, Moultan, Lahore, Meerut, other crowded Indian cities, and Aden, are probably only varieties, if not identical. The same may be said of the Bouton d'Alep, of Biskra, Bussorah, Baghdad, and Crete. Slight differences may exist, but essentially they are the same disease. The Yeman and Cochin China sores are probably varieties, as are other indolent indurated and intractable sores occurring in persons of impaired health, residing in hot and malarious climates, who use certain hard waters, and in whom there is neither syphilitic nor strumous taint.

Ætiology and Pathology.—Drs. Fleming and Smith, V. Carter, and Lewis and Cunningham give the best account of the disease. Though called a local disease, it is probable that the state of the health has much to do with its production, certain conditions of climate, soil, and especially of drinking water being concerned. Furunculi of a severe and painful though different character are prevalent in hot climates at certain seasons of the year, in enervating and malarious climates like India, especially after the rains, *i.e.* towards the termination of the most exhausting season, when the vital powers have been depressed during the preceding months, and the functions of the liver and spleen are impaired. The blood, imperfectly elaborated, and not freed from excrementitious matter, is then in a condition in which it not only ministers imperfectly to nutrition, but is prone to fibrinous coagulations, which cause capillary embolism, giving rise to local starvation and death of minute portions of areolar tissue in or under the integument. These result in suppuration, which is set up for the purpose of getting rid of the dead fragment or core. An analogous, though perhaps not precisely similar pathological condition may be concerned in the causation of the Delhi sore, and is not incompatible with an otherwise fairly good condition of the general health. Water, soil, food, bites or stings of insects, parasites, insanitary conditions, such as exist in crowded native cities, have all been charged with causing the disease. Improved hygiene, planting of trees, and change of water, food, and locality, have all been credited with benefit in the treatment of it. The

fact that this peculiar form of sore manifests itself under similar climatic conditions in other parts of the world, which, it is to be noted, are generally those of the more arid regions, and that it occurs most frequently at the most exhausting season, seems to point to a constitutional state as a predisposing cause.

The disease is not confined to human beings; in Delhi it has been observed that dogs are very liable to be affected, especially in the nose, and this, from the position of the sore, has been adduced as strong evidence in favour of the theory that it is due to the presence of a parasitic ovum which finds its way there from the water. In some districts other animals are affected; and it seems probable that the indolent, indurated, and intractable sore that horses are liable to in India, called *Bursattie* (Rain Sore) is of the same character. Further investigation into the causation and pathology of Delhi boil is needed, especially with reference to the action of drinking water, and the nature of the structures that form the essential constituents of the disease.

Anatomical Characters.—When the Delhi sore is cut into, yellowish points are seen, consisting of minute cellular growths, which have been described by Dr. Smith as the ova of a parasite (*Distoma*), and by others as of vegetable origin, but are probably the result of cell-growth, connected with the hair- and gland-follicles, perhaps an abnormal development of connective-tissue corpuscles, or an imperfect form of granulation. After ulceration has disintegrated the surface, mycelium or other low forms of organism may be present; but it is a question if these be the essential cause, and not rather an accident of the disease, introduced from without. Dr. V. Carter refers Delhi boil to a parasitic organism, consisting of spheroids and mycelium, which occupies the distended lymphatic vessels in and around the sore, arranged in open and angular meshes, the free ends giving off conidia which multiply and reproduce. Pale, round or stellate granulation-cells are found; numerous bright orange-tinted particles, arranged as spherical or ovoid groups disseminated throughout the tissues of the tumour. These, it is considered, are the fructification-stage of the fungus. Lewis and Cunningham describe lymphoid nucleated cells, the products of a condition which they consider as identical with that of lupus, and which they ascribe to the action of the chemical constituents of certain hard waters.

Symptoms.—Delhi sore commences as a small pink and reddish papule, like a mosquito bite, which gradually extends, generally around a hair-follicle as its centre. This is elevated, and after a time desquamates. There is itching and a stinging sense of pain; on pressure it is somewhat boggy. The progress of the disease is slow, often occupying several weeks, during which time it assumes a semi-transparent appearance, with blood-vessels ramifying near the surface. A vesicle then rises, bursts, and gives exit to an ichor which forms a crust; under this, suppuration and ulceration take place and advance until, by the coalescence of several papules and destruction of skin, an indurated sore is formed, which is either crusted over or fungates. The sore gradually invades the surrounding parts, and destroying the integument, may give rise, especially on the face, to deformity from cicatricial contraction; and from the irritation and the pain it causes, may, when the number and extent of the sores are large, seriously compromise the health. An ordinary boil or abrasion may assume these specific characters. The disease is regarded as contagious, and apparently may be produced by inoculation of the specific cell-matter, though not by the pus which forms on the surface.

Treatment.—*Preventive.*—Cleanliness of person, clothing, and habitation, good food, the use of pure drinking water, and careful attention to the sanitary condition of the locality,—avoiding overcrowding and contact with the disease in men or animals,—are the best means of preventing Delhi sore.

Curative.—Change of locality, when practicable; in some cases early destruction of the sore by the potential or actual cautery; the application of metallic astringents, iodine, carbolic acid lotion; pressure; attention to the state of the health, and any ailment that may be present; tonics and nutritive diet, and especially change of drinking water; and change to another climate,—are the most effective measures.

In the advanced conditions of the disease similar measures are indicated. The sore, if too extensive to be destroyed, should be dressed with stimulating and astringent applications. Soothing measures are indicated if there is pain. Black wash, sulphate and carbolate of zinc, copper, Gurjon oil, and lime water, with change of climate, and the use of tonics, will generally prove efficient.

Joseph Fayrer.

DELIRIUM (*deliro*, I rave).—A derangement of consciousness, characterised by incoherence of thought, and evidenced by various expressions and actions. *See* Consciousness, Disorders of.

DELIRIUM TREMENS (*delirium tremens*, trembling delirium).—A form of acute alcoholism, chiefly characterised by delirium and tremors. *See* Alcoholism.

DELUSION (*deludo*, I deceive).—A false belief in some fact which almost invariably concerns the patient, of the falsity of which he cannot be persuaded, either by his own knowledge and experience, by the evidence of his senses, or by the declarations of others. Such delusions, when distinguished from merely erroneous judgments upon abstract questions, generally indicate insanity. *See* Consciousness, Disorders of.

DEMENTIA (*de*, without, and *mens*, a mind).—Synon.: Fr. *Démence*; Ger. *Blödsinn*.

Definition.—A mental weakness, or a deficiency rather than an aberration of intellect, depending for the most part on some antecedent brain-disorder, such as apoplexy or epilepsy, or being the sequel and termination of various forms of insanity. It may also be congenital, deserving rather the name of idiocy; or may be due to senile decay.

1. Acute Primary Dementia.—There is a form of insanity known as primary or acute dementia, which comes on rapidly without any preceding disorder, is accompanied by the most profound vacuity and abeyance of all the mental faculties, yet yields to treatment and disappears, leaving the patients sane.

Ætiology.—The patients are young persons, boys and girls,—more frequently girls. The complaint is seldom seen in any case beyond the age of 30, and chiefly in those under 20. It seems to be a collapse of all mental power, due to great physical weakness and deficient nerve-force. Owing to imperfect development, to bad food and living, or to the patients having outgrown their strength, the mental condition becomes so weakened that, with or without some moral cause, as a fright or a scolding or something apparently more trivial, or after some illness slight or severe, they suddenly or gradually present that condition which is now to be described. If the immediate exciting cause is some mental shock or fright, the symptoms may come on rapidly. If they are due to ill-health or some protracted exhausting occupation, the access may be gradual; and if it is set down to sulkiness, temper, or idleness, the measures adopted for the correction of the latter may quickly indicate the real state of things.

Symptoms.—Nothing can appear more hopeless than the appearance many of these patients present. The face is vacant, with a fatuous grin, and often the saliva dribbles continuously. The sufferer sits motionless and lost, or automatically wags the head, snaps the jaws, or moves the limbs for hours together unconscious of fatigue. Or if a limb is placed in any position, it is retained there for a time in a way that no effort of will could accomplish. There may be a repetition of some word or sentence, but all conversation is abolished, and the patient has to be fed, washed, and tended like a baby.

The physical condition of these patients is peculiar, and corresponds closely to the mental. The heart's action and the circulation are so reduced in strength that the blood in the extremities is stagnant. Hands and feet are blue with cold even in the heat of summer. In cold weather they are covered with chilblains, and great care must be taken, otherwise these will give rise to obstinate sores. The tongue is pale and flabby, the pupils are dilated. There is no rapid emaciation, for the waste here is not great; neither is sleep absent, as in mania, but it is irregular and uncertain.

Pathology.—The external physical manifestations sufficiently indicate the condition of the brain in these patients. It is the very opposite of that in acute sthenic delirious mania. In the latter there is an excessive discharge of nervous force, an hyperæmic state of brain, and rapid brain-circulation, the whole leading in a short time to death by exhaustion if relief does not come. In acute dementia we see the very opposite. The brain-action is reduced to the lowest point, and the circulation is stagnant, as in the extremities, giving rise to passive congestion and œdema.

Course, Terminations, and Prognosis.—In acute dementia there is no sudden exhaustion; but death, if it occurs, is caused, not by the brain-disease, but by a general failure of the bodily strength, or by some low form of lung-disease — phthisis, pneumonia, or gangrene. Death, however, in this disorder is the exception. When taken in time and properly treated, the majority of these seemingly hopeless cases recover, and recover perfectly.

Treatment.—The treatment of acute dementia may be carried out in a family, or even at home, if means are ample, and if the necessary measures are strictly enforced. But it may be necessary to feed the patient by force, and that for a considerable time, and relations do not always care to enforce this to the extent required. Abundant nutrition is imperatively demanded in order to restore the force that is so greatly in defect, and unless abundant nutrition is administered, there will be no recovery, but the patient will die, or sink into permanent dementia. There is not as a rule violent resistance to food, but it may be kept in the mouth without being swallowed, and care must be taken in feeding, even if a stomach-tube be not necessary. Food should be given frequently, and so a habit of taking it engendered. Stimulants, wine and brandy, will be necessary, especially in the early stages. Equally necessary is warmth; an amount of heat is required which to those in health would be oppressive, for the greatest heat of summer fails to warm the hands and feet. Warm clothing must be provided, and the circulation aided by a short sharp shower-bath, cold or tepid, and plenty of friction afterwards. Exercise is useful for the same purpose, but this is to be taken under proper supervision, for it must not be fatiguing, and due regard ought to be had to the debilitated state of the individual. In addition to the stimulus of the shower-bath, that of electricity is of great use in acute dementia. Here, and in certain cases of melancholia, marked benefit follows the application of the constant current. Of drugs the most useful appear to be steel and quinine. The former, in this as in almost every form of insanity, is a most valuable tonic: the choice of the particular preparation should depend upon the state of the patient at the time.

2. Chronic Primary Dementia.—Dementia, however, may be primary, yet may not be that just described. It may come on gradually; or suddenly without previous mental affection, but is in such cases connected almost invariably with disease of the brain. Its first and most prominent symptom is loss of memory. In connexion with apoplectic or epileptic attacks, or after years of drinking, the memory is found defective. This may appear quite suddenly, or may be noticed to come on gradually, being at first so slight as to cause little alarm. It may vary at different times. If a patient is kept from alcohol, the memory may gain strength, and if epileptic attacks are reduced in frequency, the same thing may happen. The prognosis in all such cases is unfavourable, for loss of memory points to decided deterioration of brain. Apart from loss of memory, symptoms of dementia or weakness of mind are occasionally found as the first indication of mental unsoundness, following a fright or shock or some severe illness. If they assume the form of acute dementia, we may have

hopes that they will pass away, but if with little disturbance of the bodily health the mind becomes weaker and weaker, the hopes of recovery are small.

3. Secondary Dementia.—Of dementia which is the sequel to prior mental disorder, such as mania and melancholia, little need be said. It varies in degree, but it is not in our power to remove it. It may be in our power, however, to ameliorate in a great degree the condition of such patients when, as is frequently the case, they are found in a very neglected state. Their friends think that nothing can be done or need be done, and they are allowed to lie in bed, often in a filthy condition, or roam about and get into mischief for want of care and skilled attendance. Many demented patients have far more mind than is generally imagined by the uninitiated, and can be taught to be cleanly, to take their meals in an orderly fashion, and to keep themselves tolerably neat. They are susceptible of amusement, and open to reward for good behaviour. The vital powers of demented patients are low, and they suffer much from cold. In winter their minds like their bodies are enfeebled, and with warm weather they recover somewhat of their energy. There is a tendency in many of these patients, especially women, to become very fat, and in this condition they are subject to bronchitis, and many succumb to acute attacks of this disorder. They require warmth and good diet, for it is difficult to make them take sufficient exercise.

Females, in the writer's experience, are more prone to drift into dementia than males. The latter present various types of chronic mania, with well-marked delusions; but, among private patients at any rate, there are fewer of the hopelessly demented than among the female inmates of private asylums. One cause of this may be that the mortality amongst males is greater, and thus fewer are left to reach the demented stage.

G. F. Blandford.

DEMODEX (*δέμας*, a body; and *δῆξ*, a timber-worm).—A genus of acarine parasites, established by Owen for the reception of the human pimple mite (*D. folliculorum*), which is sometimes spoken of as the *Simonia* or *Entozoon folliculorum*. It infests the sebaceous follicles, especially those situated upon the sides and alæ of the nose. The body is vermiform, owing to the great length of the abdomen, but the entire animal rarely exceeds the $\frac{1}{50}$ of an inch from head to tail. Gruby and others have succeeded in inoculating dogs with this parasite, which has also been found in mange-affected animals not previously subjected to experiment. In man, when occurring in large numbers, they cause the formation of prominent pimples, which often present an unsightly appearance. Each whitish spot or enlarged follicle presents to the naked eye a terminal black point, and it contains not only full-grown animals (having their tails directed towards the opening) but also eggs, larvæ, and exuviæ. Their presence rarely gives rise to inconvenience other than that resulting from unsightliness. Infected persons, however, are extremely glad to get rid of them, and this may be done by the application of mercurial ointments, by the frequent use of a corrosive sublimate lotion (2 grains to 1 ounce of water), or, as the writer has found, by rubbing-in glycerine of carbolic acid after warm water fomentations. A coarser method of treatment consists in evacuating the pustular contents by small incisions and pressure. By forcibly bursting the follicles and squeezing out the contents small ugly scars are apt to be subsequently formed. *See* Acarus.

T. S. Cobbold.

DEMULCENTS (*demulceo*, I stroke softly).

Definition.—Substances which soften, protect, and soothe the mucous membranes. They are generally of a mucilaginous character; and when applied to the skin are termed *emollients*.

Enumeration.—The demulcents in ordinary use are—Linseed-tea, Gum, Starch, Bread, Honey, Figs; Linseed, Almond, and Olive Oil; Glycerine, White-of-Egg, Gelatine, and Isinglass.

Action.—The chief action of demulcents is a mechanical one, in forming a smooth, soft coating for an inflamed mucous membrane, and thus protecting it from external irritation.

T. Lauder Brunton.

DENGUE.—Synon.: Dandy fever (West Indies); Three-day fever; Break-bone fever; Fr. and Ger. *Dengue.*

Definition.—An infectious, eruptive fever, commencing suddenly, and characterised by severe pain in the head and eyeballs; swelling and pain in the muscles and joints, prone to shift suddenly from joint to joint; catarrhal symptoms; sore-throat; congested conjunctivæ; and affection of the submaxillary glands. The disease may remit, and is liable to relapse.

Natural History and Geographical Distribution.—Dengue occurs epidemically and sporadically in India, Burmah, Persia, Egypt and other parts of Africa, North and South America, and the West Indies. It is not known in Britain. Epidemic visitations of dengue, extending over wide tracts of country, occur at considerable intervals, and probably depend on certain unknown atmospheric and cosmic conditions that favour its development.

Ætiology.—Dengue attacks persons of all ages, from infancy to extreme old age. It certainly is infectious, as has been proved by many cases in which the disease has been conveyed from person to person.

Symptoms.—Those characteristic of dengue are the presence of severe continuous arthritic and muscular pains; great debility and prostration; the occurrence of an initial and a terminal rubeoloid or scarlet rash; fever, which is subject to remissions and relapses; the possibility that convalescence may be tedious and painful, and complicated by the continuance of general cachexia, pain and swelling of joints, enlargement of glands, orchitis, weakness of eyes, deafness, visceral disease (such as diarrhœa or dysentery of a chronic and intractable character, and hepatic derangement) boils, carbuncles, and perhaps insanity. In the female, uterine hæmorrhage and miscarriage may occur.

The *invasion* of dengue is usually sudden, the patient feeling well up to the period of attack. The earliest symptom is severe pain in some

joint, probably of a finger, which rapidly extends to all the other joints and bones; and this pain during the progress of the disease often passes from one joint to the other by a sort of metastasis. Sometimes there is a period of preliminary malaise, of one or more days' duration, marked by anorexia, a sense of weariness and languor, giddiness, nausea, chilliness or rigor, severe pain in the head—localised or in the eyeballs, and pains in the body, limbs, and joints, notably of the fingers and toes. The attack is often, however, strikingly sudden, as was frequently seen in the last Calcutta epidemic, commencing with violent pains and swelling of the joints, or severe pains in the head, eyeballs, neck, and back. In some epidemics certain phenomena are more prominently marked than others.

The eruption commences on the third day. The fever is accompanied by redness of the face, which is puffy and swollen; sore-throat; congested conjunctivæ; and a general redness, like the scarlatinal rash, extending over the whole body. The tongue is red at the tip and edges, and loaded with white fur, through which the red papillæ protrude. The pulse is rapid, ranging from 102 to 120, or even 140; respiration is hurried; and the temperature rises to 103° or even 105°. These symptoms mark the occurrence of the initial fever and rash, and endure for a period varying from one day to forty-eight hours. After this the rash disappears, the fever subsides, and the remission lasts for a period of two, three, or four days. A recurrence of febrile symptoms then takes place, accompanied by a second, or terminal rash. This differs in character from the first, resembling a rubeoloid or even an urticarial eruption, often showing itself first on the palms of the hands, and in some cases resulting in profuse desquamation of the cuticle, though it may sometimes be so slight as to be barely perceptible. These symptoms gradually subside, leaving the patient weak, exhausted, and often still tortured by swelling and pain of the joints, especially the smaller ones, which may continue in this state for weeks, making convalescence tedious and painful. Or there may be repeated relapses, prolonging the suffering and protracting recovery.

Varieties.—The symptoms vary in different cases, as to the character of the rash, the temperature, and the muscular or osseous pains.

The *rash* not only varies considerably in colour, character, and duration, but it is sometimes almost absent; in other cases it is attended with so much hyperæmia and action of the skin that excessive desquamation results. This hyperæmia also sometimes expresses itself by hæmorrhage from the mouth, nose, bowels, and uterus.

The *fever* is sometimes accompanied by delirium, or in children by convulsions; in the latter, indeed, these occasionally initiate the disease.

Dengue occasionally assumes a *malignant* form, where the amount of poison received has been overwhelmingly large. Dr. Charles says: 'Drowsiness may have passed into coma; the temperature verges on the hyperpyretic; the heart fails, and the lungs are œdematous: while the whole surface is highly cyanotic. These cases have been popularly termed "black fever," and are justly much dreaded.' Happily such cases are rare. Again, there are very mild forms of the disease, in which the patients are scarcely ill, and where it is not easy to decide as to their exact nature; 'A trifling sore throat and slight malaise may be all you can lay hold of till the terminal rash appears to show you what you have had to deal with; and even this may not be seen.'

Course, Duration, and Complications.—The period of *incubation* of dengue is probably from five to six days; it may be a day or two more or less in some cases.

In simple and uncomplicated cases the average period for the *duration* of the disease may be taken as about eight days; but it is frequently prolonged over weeks, and recovery is slow and painful; the constitution often being so much shattered that complete restoration to strength and vigour does not occur for months. It is rarely fatal. *Relapses* are liable to be frequent, and the patient may suffer more than even a second or a third relapse before recovery.

Some of the *sequelæ* already mentioned may remain to torture the patient and retard his recovery. Albumen is occasionally present in the urine; but it is not, as in scarlatina, especially in the cases of children, a frequent or dangerous result of the disease.

Diagnosis.—The distinction betwixt scarlatina and dengue is well marked; though during the outset there is considerable resemblance between the two diseases. There is a high temperature at first in both, but it is more quickly attained, and is transient in dengue; in scarlatina it endures for several days, whilst in dengue the fastigium gives a temperature of 103°, or even up to 105° or 107°, and this being attained it rapidly declines. It is exceptional to find a temperature above 102° maintained in dengue. In scarlatina the period of decline extends over several days, and is marked by slight exacerbations in the evening. In dengue it occupies a few hours, and the temperature may even fall below the normal standard. The severe muscular and arthritic pains of dengue do not occur in scarlatina; and the pulse in the latter is much more rapid in the early stages than in the former. The initial rash in dengue occurs sooner than the eruption in scarlatina.

Prognosis.—An attack of dengue does not confer absolute protection from a recurrence of the disease, though it does so to a great extent.

Treatment.—This is a specific fever, and has to run a certain course. The treatment is simple, and if judiciously directed mitigates the sufferings, and materially aids recovery.

Neither emetics nor active purgatives are necessary. They do no good, but increase the weakness and aggravate the suffering by the muscular movements necessarily induced. Moderate action of the bowels is advisable, followed by a warm carminative aperient, or an occasional dose of calomel, rhubarb, or colocynth, especially if the bowels remain confined, to which there does not appear to be any peculiar tendency, though the evacuations may be dark and often slimy, and confined at the outset. Salines, such as the acetate of ammonia, or citrate of potash

with nitric ether, combined with aconite, are good during the pyrexia. In cases of very high temperature (105° to 107°) Dr. Charles suggests cold-sponging as beneficial; he recommends it when 105° is reached. The danger to life of such a high temperature during the intense heat of the hot months in India is great; and it is then that cold sponging or the cold bath is indicated.

Belladonna seems to confer great relief in this disease; ten to fifteen drops of the tincture may be given, and two or three such doses at intervals of an hour will sometimes produce excellent effects, and afford much relief. The extract may be given if preferred, in doses of one-third of a grain; or the juice in similar doses to those of the tincture. For the pains and nocturnal restlessness, morphia or Dover's powder may be given. Liniments containing opium, belladonna, and chloroform are serviceable as external applications to the spine, back, and joints.

Tonics, and a carefully-regulated nutritious diet, are also indicated, and depletive measures must be avoided. The tonics should be of the bitter vegetable kind, such as gentian and calumba; with these may be combined a small quantity of quinine, with a mineral acid; or, in some cases, the dilute phosphoric acid, combined with nux vomica or small doses of strychnine.

Quinine is given more for its tonic than for its antiperiodic effects; though, where there is a tendency to relapses, the judicious administration of five- or even ten-grain doses may be beneficial in arresting them. Bromide of potassium is recommended by some authorities, and especially when convulsions occur in children. Alkalies, colchicum, and other remedies in use in rheumatism have been found to have little, if any, effect in relieving the pains of dengue.

As to wines, claret is probably the best, but others may be given.

For the irritation of the skin, which is sometimes very troublesome, the application of camphorated oil, and the use of warm baths have been suggested.

As in so many other diseases, especially those that occur to Europeans in tropical climates, complete restoration to health is likely to be expedited and promoted by change of air; and if the cachexia be severe after a prolonged attack of the disease, return to the patient's native climate for a season is desirable.

JOSEPH FAYRER.

DENTITION, Disorders of. — SYNON.: Teething; Fr. *Troubles de la dentition*; Ger. *Zahnen.*

GENERAL REMARKS.—The period of cutting the teeth has been always recognised as a critical time, during which the health of young children is especially liable to become disturbed; and it has been a common practice amongst mothers to attribute every illness occurring in early life, from the irritation of scabies to the distortions of rickets, to the same baneful influence. The evolution of the milk-teeth is no doubt attended with some irritation, especially as at this period the follicular apparatus of the intestines is undergoing considerable development and we know that, on account of the impressibility of the nervous system in young children, any irritation is apt to be followed by general disturbance. It is no doubt also the case that local functional derangements are frequent at this period, but it is often unfair to attribute these *directly* to the irritation of an advancing tooth. One of the most common direct results of teething is pyrexia, which may be intense; and a feverish child is particularly susceptible to impressions of cold, and to the irritation of unsuitable food. Catarrhal attacks coming on at this time need not be therefore the immediate result of the condition of the gum. It is at least equally admissible to attribute them to the ordinary causes of such derangements acting upon a body rendered for the time peculiarly susceptible to injurious influences. This view is supported by the fact that diarrhœa, which is a very common complication of dentition, is especially frequent during the warmer months, when the temperature is apt to undergo rapid variations, while the dress of the child remains unchanged; and is far less common during the winter, when the temperature is more uniform, and the child is more carefully guarded against the cold.

As a rule, the first milk-tooth appears in the seventh month after birth; but dentition may begin at an earlier period. It is not rare for an infant to cut a tooth at the age of four months, and occasionally at the time of birth one tooth is found to be already through the gum. In cases where the ordinary time of weaning is anticipated, a pause generally ensues after the appearance of one or two teeth, and further dentition is delayed until the usual age. Constitutional conditions influence the time of teething. Thus tuberculous and syphilitic children cut their teeth early, while in rickety children the teeth are very slow to appear.

In the majority of cases the teeth pierce the gum in the following order—lower central incisors, upper central incisors, upper lateral incisors, lower lateral incisors, first molars, canines, back molars. A child of twelve months old should have eight teeth and be cutting his first molars, and the whole number (twenty) should be through the gum soon after the end of the second year. The order given above is not adhered to invariably. The incisors are often cut irregularly, and the first molars may precede the lateral incisors. The canines seldom or never precede the first molars.

Some infants suffer more than others from the cutting of a tooth, and it is not always in cases where the eruption of the teeth has been delayed that dentition, when it occurs, is attended with special inconvenience. On the contrary, in severe rickets, where the delay is great, the teeth are often cut with remarkable ease.

SYMPTOMS.—The phenomena which may be looked upon as natural to the process of dentition are salivation; swelling of the gum, which becomes more and more tense, hot, and painful; slight general pyrexia, with flushing of one or both cheeks; irritability of temper; and some degree of restlessness at night. These all subside when the point of the tooth appears through the gum. The complications not necessarily

attendant upon the process are high fever; inflammation of the mouth and aphthæ; vomiting (gastric catarrh); diarrhœa (intestinal catarrh); cough (pulmonary catarrh); various eruptions of the skin, with, sometimes, swelling, and even suppuration of lymphatic glands; and certain troubles of the nervous system, such as convulsions, squinting, &c.

The peculiarity of the pyrexia of dentition is its irregular character. It is often higher in the morning than at night, and varies in intensity in a remarkable manner from day to day. A temperature of 104° Fah. at 8 A.M. is not at all uncommon in a teething infant; indeed such an amount of fever in the morning should alone lead us to inspect the mouth, as few diseases are marked by so much pyrexia at that hour of the day. It is important in practice to bear in mind this simple cause of elevation of temperature, for any disease in a child is apt to be complicated by teething, and much needless anxiety may be occasioned by overlooking the condition of the gum. We must not, however, in every case where the gums are swollen and tense, rush to the conclusion that they are the sole cause of the symptoms, for the most serious cerebral disease may co-exist with the eruption of a tooth. Thus, to take an example:—if we find cerebral symptoms to supervene in the course of dentition, we must most narrowly scrutinize their character, before passing them over as merely harmless indications of the general disturbance. Headache, delirium, vertigo, startings, twitchings, and convulsive attacks, may merely indicate functional disturbance of the brain such as is common to many disorders, and these phenomena are not necessarily symptomatic of cerebral disease; but if the bowels become obstinately confined, the pulse slow and irregular, and the respiration unequal and sighing; and if in addition there be photophobia, with sullenness and tendency to drowsiness, we may conclude that something more than mere functional derangement is present, and that there is every reason to suspect the existence of tubercular meningitis.

Treatment.—The treatment of the complications which occur during dentition must be conducted upon ordinary principles. Aphthæ of the mouth are readily cured by the administration of rhubarb and soda, and the application to the mouth of a solution of chlorate of potash or borax in glycerine (ten grains to the ounce). Perfect cleanliness is, however, necessary, and the child's mouth should be washed out each time after taking food with a piece of soft rag dipped in warm water.

Vomiting is best checked by clearing out the stomach with an emetic of ipecacuanha wine, giving a tea-spoonful every ten minutes until sickness is produced. Afterwards a few grains of carbonate of soda may be given with one drop of liquor arsenicalis in a tea-spoonful of water three times a day. Diarrhœa should be treated on the same principle:—first a dose of castor oil to remove irritating secretions from the bowels, then a mixture containing chalk and catechu, or oxide of zinc (one grain to the dose). If afterwards the motions continue large, pasty-looking, and offensive, and are passed too frequently in the day, one drop of tincture of opium may be added to the mixture, as there is usually in such cases too rapid peristaltic action of the intestines. In the case of either of these derangements (vomiting or diarrhœa) it is of great importance to keep the body warm, and this is most effectually done by applying a broad flannel bandage to the abdomen. The diet also should be temporarily modified, reducing the quantity of farinaceous matter that is being taken, on account of the tendency to acid fermentation of food which is set up by such a condition of the alimentary canal.

Looseness of the bowels during dentition has been looked upon by some writers as a natural method of relief to the system, and fears have been held out of grave troubles which might ensue if the looseness were too suddenly arrested. Such fears are, however, quite groundless. A catarrhal condition of the bowels should be cured as quickly as possible, especially during dentition, for it is at this time that the susceptibility to chills is so great, and the danger of severe choleraic diarrhœa being set up is therefore correspondingly threatening. In some cases of teething, where the lungs as well as the bowels are the seat of catarrh and there is a risk of bronchitis, Trousseau recommends that the intestinal derangement should not be suddenly put an end to: but even in these cases a dose of castor oil may be safely given to remove irritating matters from the canal, for, according to the writer's experience, any irritation of the bowels is apt rather to increase than to diminish pulmonary mischief.

The favourite remedy for all disorders occurring at the time of dentition is lancing the gums, but the practice is one which ought not to be pursued indiscriminately. Unless the gum be actually swollen and tense, incising it has no object whatever, for to cut the top of the gum can have no influence in promoting the development of the tooth below. If, however, there be very much inflammation and swelling, and the child seem to be in pain, relief may be obtained by lancing, but in this case the object is merely to relieve tension. Excitement of the nervous system dependent upon the condition of the mouth can perhaps be allayed by the same means; but in the case of convulsions more benefit is to be gained by the use of warm baths, cold applications to the head, and the gentle action of a mild aperient.

Eustace Smith.

DEODORANTS (*de*, from, and *odoro*, I cause to smell).

Definition.—The term deodorant, although it has a more extended signification, is generally used to signify a substance that destroys offensive odours.

General Principles.—Odorous bodies are essentially volatile, and those which are offensive frequently contain sulphur in some state of combination. Deodorants usually produce the effect for which they are used by causing a chemical change in bodies to which they are applied; but sometimes their action consists in absorbing and condensing odorous substances, and thus destroying or counteracting their volatility. Substances which, like charcoal, possess this latter property may, however, indirectly produce chemical changes by bringing the odorous sub-

stances into contact with oxygen in a condensed and active condition.

Deodorants may be classed as *volatile* and *non-volatile*.

1. Volatile Deodorants.—These all consist of substances the action of which is immediately and exclusively chemical. Being intended to act on bodies which are themselves volatile they admit of more generally useful application than those which are not volatile.

ENUMERATION.—Chlorine and its lower oxides, Sulphurous Acid, Nitrous Acid and other oxides of nitrogen, Ozone and Peroxide of Hydrogen are the most important members of this class.

APPLICATION.—In the selection and use of volatile deodorants, it is necessary to distinguish between bodies which possess the power of destroying or removing a noxious smell, and those which merely cover one smell by another. Carbolic acid, for instance, which is a valuable disinfectant, is of little use as a deodorant, although its powerful odour may render other weaker but more objectionable odours imperceptible or indistinguisable. On the other hand, the so-called chloride of lime (chlorinated lime of the Pharmacopœia), while it possesses a strong and characteristic smell itself, is capable of destroying other noxious odours, and is an excellent deodorant.

The chemical action by which noxious odours are destroyed is principally one of oxidation, and therefore this class of deodorants are generally oxidising agents. Ozone, or active oxygen, is the natural deodorant contained in the atmosphere, which no doubt largely contributes to the destruction of noxious vapours in the air. Volatile oils, which emanate from the flowers and other parts of plants, in contact with atmospheric oxygen produce peroxide of hydrogen, and this as an oxidising agent possesses deodorising as well as disinfecting properties. The moderate and judicious use of perfumes may thus produce a beneficial effect, although their undue employment, by hiding more than removing what is objectionable and may be injurious to health, cannot be recommended. The preparation called 'Sanitas' is principally a solution of peroxide of hydrogen.

2. Non-volatile Deodorants.— ENUMERATION.—Among this class of deodorants are included Charcoal, Earth, Lime, Oxide of Iron, Sulphate of Iron, Chloride of Zinc, Nitrate of Lead, and Permanganate of Potash.

APPLICATION.—Although very efficient when brought into contact with the class of odorous substances referred to as noxious gases, these deodorants are less generally useful than they would otherwise be on account of their non-volatile character. Charcoal owes much of its efficacy as a deodorant to the surface-attraction and power of condensation which it possesses, by virtue of which it brings noxious gases such as sulphuretted hydrogen into contact with oxygen in a condensed and active state, so that they are burnt up and resolved into innocuous compounds, or compounds less noxious than those from which they are produced. Earth and oxide of iron, which, like charcoal, are used in the solid and dry, or nearly dry state, absorb and combine with, or promote the combination of, noxious gases, producing innocuous products. Lime may be used either dry or in the state of milk of lime. The other substances named are used in the form of solution in water. Where large quantities of decomposing animal or vegetable matter are required to be deodorised, dry lime or solution of sulphate of iron (green vitriol) may be economically and advantageously used. T. REDWOOD.

DEPILATORIES (*depilis*, without hair). SYNON.: *Psilothron*, *Rusma*.

DEFINITION.—Depilatories are agents used for destroying the hair by means of their chemical properties.

ENUMERATION AND ACTION. — Depilatories usually consist of powders, of which the chief constituents are quicklime (three parts), and sulphuret of sodium (one part), diluted with (four parts of) starch. The powder is mixed with water to the consistence of a thin paste, and laid on the part to be operated on by means of an ivory paper-knife. In from five to fifteen minutes the paste should be carefully scraped off, when the hair, shrivelled and burnt, will come with it. The skin must then be washed with fresh water, and dried, and anointed with cold cream. A strong solution of sulphuret of barium, made into a thin paste with starch, is a powerful depilatory.

ERASMUS WILSON.

DEPLETION (*depleo*, I empty). SYNON.: Fr. *déplétion*.

DEFINITION.—By depletion is understood (*a*) the unloading, or rendering less full, of that which is over-burdened or over-full, for example, portions of the turgid vascular system —as the portal vessels; or (*b*) excessive evacuation causing exhaustion—as in choleraic or other severe diarrhœa.

USES.—Depletion, local or general, as a therapeutic agent, may be practised in a variety of affections, such as cerebral congestion, venous turgescence, engorgement of the portal system, pulmonary congestion, renal ischæmia, or general plethora.

METHODS.—The agencies whereby depletion may be produced are blood-letting, general or local, purging, sweating, vomiting, and abstinence from food and drink.

1. General Blood-letting.—There is no more powerful or prompt depleting agent than general blood-letting by venesection or arteriotomy; indeed, the chief indications for bleeding are to be found where it serves a depleting purpose—as in engorgement of the right heart and venous system, visceral congestion and arterial turgescence. (*See* BLOOD, Abstraction of.) It is seldom, however, that abstraction of blood needs to be carried to such an extent as to exert a marked depleting effect on the whole system; it is required, rather, for the relief of limited vaso-motor disturbances.

2. Local Bleeding.—Bleeding by means of leeches, scarifications, or cupping, may serve a very valuable depleting purpose in limited congestions, as in those of the pericardium, pleura, peritonæum, lungs, eyes, kidneys, tongue, uterus, and hæmorrhoidal vessels.

3. Purgation.—For general depleting purposes free purging by means of hydragogue

cathartics is the most efficacious agent. In cerebral, cardiac, and hepatic congestions, when it is required to give relief to turgid vessels without abstracting blood, nothing depletes so readily, efficiently, and safely as watery purges. The best purgatives are:—Elaterium, jalap, senna, scammony, sulphate of magnesia or soda, tartrate of soda, bitartrate of potash, croton oil, and gamboge; to which may be added, podophyllin, calomel, and antimony. Watery purges have the great advantage of depleting by removing serosity from the blood-vessels without the loss of red corpuscles. In cerebral congestion depletion by means of such purges is of cardinal service. In congestion of the intestinal tract arising from hepatic, cardiac, or pulmonary disease, a mercurial followed by a saline purge is of great service. Antimony has been mentioned in the above list because of its usefulness in combination with sulphate of magnesia and other saline purges. It should be remembered that it also acts as a depressant, and should only be used when such action is permissible.

4. Vomiting.—When used as an emetic, antimony has a powerfully depressant, as well as evacuant or depletory effect; but depression and depletion are not synonymous. The lowering effect of free purging is pronounced, and ordinarily, sufficient. Emetics may act as depletants by evacuating the contents of, or producing a flux from, the stomach; but their depressant action is always to be borne in mind when used with this object.

5. Sweating.—This is a less effectual mode of depletion. It may serve a good purpose, when freely induced, in lowering arterial tension, as in cases of renal disease, especially if there be pyrexia. Active exercise, the hot air (or Turkish) bath, the vapour bath, wet packing, jaborandi, antimony, and Dover's powder are the usual modes of exciting diaphoresis. Diaphoretics are often aided by copious draughts of hot fluids. The evacuant action of sweating and purging may be advantageously combined when speedy depletion is desired. The combination is valuable in certain dropsies.

6. Abstinence.—General depletion may be produced by abstinence from food and drink, and is sometimes employed in the treatment of aneurism, and of strangulated hernia containing omentum, the absorption of the fat of which is the object aimed at by starvation.

ALFRED WILTSHIRE.

DEPOSITS.—The term deposit had at one time a much wider extension in pathology than it has now. In accordance with the doctrine of morbid *crases* or *dyscrasiæ*, it was customary to regard cancers and all new-growths, the products of tubercular and scrofulous diseases, as well as those of the specific fevers and ordinary inflammation—in fact almost every kind of morbid product in the body—as 'deposited' from the blood in consequence of some alteration in its composition. In many of these cases the term deposit is still often used, even though an entirely different view may be taken of the processes leading to these morbid changes. The name remains, though the idea has departed; and this is also true of other morbid products called deposits. The term *secondary deposits* was formerly used for what are now called pyæmic or secondary abscesses, from a belief that pus was removed from the original seat of disease, and deposited in distant parts. The term *atheromatous deposit* is due to Rokitansky, who described this change as due to the deposition upon the arterial wall of material precipitated from the blood. In both these cases the term seems now misleading. Again, several processes which we now call degenerations or infiltrations were formerly spoken of as deposits; for example, lardaceous, fatty, and pigmentary deposit; and although these processes may now be better described by another name, it cannot be doubted that in some of them an extraneous substance is actually deposited in the tissues. The term *fibrinous deposits* was also used for the masses now known as infarctions or blocks (as for example in the spleen or kidneys) where the appearance of a mass of extraneous material is produced by the degeneration as a mass of tissue, mixed with products of hæmorrhage, inflammation, and exudation. In quite another sense the various substances precipitated from urine are spoken of as *urinary deposits*, with which we are not here concerned.

When these exceptions are made, the present use of the word *deposit* is a limited one, but is appropriate in those cases where something different from the elements of the tissue, and especially if it be an inorganic material, is found in their substance, and when it may reasonably be supposed that this material has been brought to the tissues by the circulating fluid and there deposited. The term is clearly inappropriate when the foreign matter is formed by some chemical change in the substance of the tissue-elements, but between such cases and those just mentioned it is very difficult to draw the line. We shall speak, in the sense just defined, of *calcareous*, *metallic*, and *pigmentary* deposits.

1. Calcareous Deposits.—All calcification of the tissues of the body, whether normal or degenerated, of inflammatory products, of new growths, or of any morbid products, appears to depend upon the deposition of lime-salts in the form of granules, this deposition taking place either within the substance of the elements, or more rarely in the intercellular substance, or, possibly, sometimes in the interstices of the tissue. Calcareous deposit takes place towards the close of life in several parts of the body, as in the walls of arteries, in cartilages and tendons, in the valves of the heart, the crystalline lens of the eye, and other parts; though in most of these cases, if not in all, some other pathological change precedes the deposition of lime. Still more frequently this change occurs in masses of dead or degenerated materials, as, for instance, in organs which have partially or wholly lost their vitality, in new-growths which have reached the stage of retrogressive change, in old blood-clots, or in products of bygone inflammation. A wasted eyeball always becomes partly calcified (sometimes ossified); tumours, such as myoma and fibroma, are especially subject to calcification; venous clots which remain long undisturbed, as in the deep veins of the pelvis, undergo the same change, and become phlebolithes. Old inflammatory products, as pus and lymph, seem to

become necessarily calcified if they are not absorbed; so do especially the products of chronic degenerative inflammations which have become necrotic, as seen in scrofulous lymphatic glands, and in tubercular masses in the lungs. A similar explanation applies to calcareous deposit in the walls of arteries, where the lime is generally deposited in new products which result from chronic arteritis or the atheromatous process, though lime may also be deposited in the muscular walls independently of atheroma. Necrotic masses resulting from embolic infarction are frequently calcified. Parasites of all kinds, occurring in solid organs, are liable to become surrounded by a calcified wall: a change frequently seen in hydatid cysts.

From all this it appears that calcareous deposit rarely occurs in normal healthy tissues, but is common in such parts as are dead or of deficient vitality. Its deposition must be attributed to some chemical reaction between the tissues thus altered and the lime-salts in the blood, and it is possible that the presence of an excessive quantity of lime-salts in the blood sometimes favours the change, since deposition of lime in one part sometimes coincides with removal of it from another part. In senile decay the wasting of bones goes on simultaneously with the calcifying processes just mentioned, and in some rare cases rapid absorption of bone from special disease has appeared to be the determining cause of its deposit elsewhere by a sort of *calcareous metastasis*.

2. **Metallic Deposits.**—Other minerals besides lime-salts are rarely found deposited in the tissues, although in cases of chronic metallic poisoning, compounds of lead, silver, and copper may be found thus deposited. Zinc and mercury are less clearly traced, but probably follow the same law. The state of chemical combination in which the metals occur is not positively known, but appears to be some combination with albumen.

3. **Pigmentary Deposits.**—Pigmentation as a process is discussed in the article DEGENERATIONS, and has been shown to depend very frequently upon the occurrence of hæmorrhage and transformation of the extravasated blood. But pigment is deposited in many parts of the body, both normally and pathologically, quite independently of hæmorrhage. Normally this is seen in the skin, the choroid coat of the eye, &c.: pathologically in the same situations, but in excessive quantity; and also in abnormal situations, as on the mucous membrane of the mouth. The arrangement of the pigment is in every case the same, forming minute black granules in the protoplasm of the cells around the nucleus. Its deposition and removal are regulated by causes as yet very imperfectly known, but are probably in some way dependent upon the nervous system.

The deposit of such substances as fat, lardaceous material, colloid, &c., is not a simple process, but depends either upon chemical metamorphosis of the cell, or on general pathological changes, which are dealt with in other parts of this work.

J. F. PAYNE.

DERBYSHIRE NECK.—A synonym for goitre, which is thus called from the prevalence of the disease in that county.

DERIVATIVES (*derivo*, I drain).

DEFINITION.—Medical appliances or remedies which lessen a morbid process, such as inflammation, in one part of the body, by producing a flow of blood or lymph to another part.

ENUMERATION. — Derivatives include — Local bleeding, Cupping, Leeches, Blisters, Sinapisms, and Setons.

ACTION.—The name 'derivative' was applied in ancient times under the belief that diseases were caused by morbid humours, which might be drawn away from the part which they were affecting. It is now used chiefly to signify the diminution of blood in an inflamed part, by increased circulation in some other vascular district, either adjoining or remote from it.

T. LAUDER BRUNTON.

DERMATALGIA (δέρμα, the skin, and ἄλγος, pain).—Pain and aching in the skin. *See* NEURALGIA.

DERMATITIS (δέρμα, the skin).—Inflammation of the skin, a term applicable to every variety of inflammation of the integument, but especially to an acute inflammation attended with exfoliation of the cuticle and copious desquamation, for example, *Dermatitis Exfoliativa*, the *Pityriasis rubra* of Devergie.

DERMATOLYSIS (δέρμα, the skin, and λύσις, a loosening).—Looseness or relaxation of the skin. *See* CUTIS PENDULA and MOLLUSCUM.

DESQUAMATION (*de*, from, and *squama*, a scale).—The process of separation or shedding of the epithelium of any surface. It is of most importance in connection with the skin in scarlatina, where the epidermis usually desquamates extensively.

DESQUAMATIVE NEPHRITIS. — A synonym for certain forms of Bright's Disease, applied on account of the shedding of the epithelium lining the tubules, which is characteristic of the disease. *See* BRIGHT'S DISEASE.

DETERGENTS (*detergo*, I cleanse).

DEFINITION.—Substances which cleanse the skin.

ENUMERATION.—The principal detergents are—Water, Soap, Alkalies, Ox-gall, Milk, Vinegar, Charcoal, Sand, Oatmeal, Sawdust, Pumice-stone, Oil, and Borax.

USES.—Detergents are used either to remove extraneous dirt adherent to, or epidermal scales which may have accumulated upon the skin, and interfere with its function. The chief detergent is warm water, but its action is greatly aided by such substances as soap, alkalies, borax, or vinegar, which act chemically in the removal of dirt or epidermis; or by such substances as oatmeal, sawdust, charcoal, pumice-stone, and sand, which act mechanically. Oil removes the resinous deposit left on the skin by plasters. Where the skin is tender, as in the case of the scalp, and where at the same time the detergent employed cannot very readily be removed, borax with elder-flower water may be found preferable to the more irritating soaps as a means of removing scurf.

T. LAUDER BRUNTON.

DETERMINATION OF BLOOD.—Increased flow of blood to a part or organ, synonymous with *active hyperæmia* or *active congestion*. *See* CIRCULATION, Disorders of.

DEVELOPMENT, Arrest of.—The causes of arrest of development are in most cases still very doubtful, and for the most important theories and observations on the subject the reader is referred to the article on MALFORMATIONS. Such arrests may take place at any stage in the development of the embryo and of its organs; but only the most important of them, and the mode in which some typical examples are brought about, will be mentioned here.

VARIETIES.—Those which occur very early in fœtal life are complex and, for the most part, incompatible with viability; whilst those which occur later often affect only one organ or a set of organs, and in some cases form no barrier to a prolonged existence. Not only must the fœtus be considered, but also the placenta and membranes in which it is enclosed *in utero*; for diseases of these lead to many forms of monstrosity, either by interference with the nutrition and respiration of the embryo, as in the case of many so-called 'true moles'; or the normal changes may be checked by adhesions between them and the fœtus. Persistence of the umbilical vesicle is excessively rare, but a patent vitelline duct is very common, and explains many of the diverticula in connection with the small intestines. A want of closure of the visceral laminæ is the source of many deformities, from a simple fissure in the sternum, or a ventral hernia, to a complete anterior cleft, with the thoracic and abdominal viscera lying bare out of the body-cavity. In other cases the skin and muscles only may cover the viscera, or the muscles may not be developed. The thorax is closed before the abdomen, so that ectopia of the abdominal is more common than of the thoracic viscera. The abdomen, however, is sometimes closed in, whilst the thorax remains open, and varying degrees of ectopia cordis result; but this is rarely complete. Epispadias and hypospadias to varying extents are further examples of imperfect fusion of the ventral laminæ. These may or may not be attended with displacement or deficiency of the urinary and genital organs. Similarly from an incomplete fusion of the dorsal laminæ the various forms of spina bifida occur, and these are generally accompanied with an excess of fluid in the spinal canal, or hydrorachis.

The arrests in the development of the cerebro-spinal centres and of the organs of special sense are very numerous. The whole brain may be wanting, or the medulla oblongata developed and the remaining portions missing, or any given part of it may be absent or quite rudimentary. From incomplete fusion of the bones of the skull hernia cerebri or encephalocele occurs, and this is generally complicated with hydrocephalus, though the latter is frequently found as an independent and solitary affection. Coloboma and deficiency of the olfactory, optic, or auditory nerves are well-known examples of arrested development of the organs of special sense. The special malformations of the heart and vascular system, the digestive, respiratory, and urino-genital systems, will be described under the various organs; but reference must here be made to congenital fissures leading into the pharynx (persistent branchial clefts), to the various fissures of the face and palate, to persistent cloacæ, to the numerous forms of hermaphroditism, and to imperforate anus, as all coming under this head. Varying degrees of ill-developed extremities are common, from a diminution of number in the fingers or toes, or their coalescence, to a complete absence of one or all the limbs. Finally, ducts, vessels, and openings—such as the urachus, ductus arteriosus, umbilical vessels, and foramen ovale—which normally close soon after birth, may remain patent throughout life. JOHN CURNOW.

DEVONSHIRE COLIC.—A synonym for lead colic, which has arisen from the frequency of lead-poisoning in that county, supposed to be due to the contamination of cider by lead. *See* LEAD, Poisoning by.

DIABETES INSIPIDUS (διά, through, βαίνω, I flow; and *insipidus*, tasteless).—SYNON.: Polyuria; Fr. *Diabète insipide* or *non sucré*; Ger. *Polyurie*. A synonym for Polyuria. *See* POLYURIA.

DIABETES MELLITUS (διά, through, βαίνω, I flow; and μέλιττα, a bee).—SYNON.: Glycosuria; Fr. *Diabète*; Ger. *Harnzuckerruhr*.

DEFINITION.—The term Diabetes, meaning an excessive flow of something, has been applied to the pathological condition indicated by an excessive flow of urine. It has, moreover, been almost wholly limited to the kind of malady characterised by the presence of a notable quantity of sugar in the urine—a condition more strictly described by the term Diabetes Mellitus. Another condition is sometimes seen where no sugar is to be found in the urine, which is, however, excessive in quantity. This is designated as Diabetes Insipidus, or better, Polyuria.

Diabetes is a malady more or less chronic, characterised by the persistent presence of a notable quantity of sugar in the urine, which is in most cases markedly abundant. It is accompanied by thirst, hunger, and bodily wasting. If unrelieved it invariably tends to death. The ordinary form of Diabetes is thus to be distinguished from certain other conditions, where, for instance, a small or hardly perceptible trace of sugar may be detected in the urine; or where, yet again, considerable quantities of that substance may be detected occasionally, and for a short time only. To this abnormal condition the term *Glycosuria* (γλυκύς, sweet, and οὖρον, urine), which is often also employed to describe artificial diabetes, best applies.

GENERAL CONSIDERATIONS.—Three important facts lie at the bottom of our knowledge of the pathology of Diabetes.[1]

These are:—

I. That grape sugar is found in the healthy human body.

II. That glycogen, a substance closely allied in chemical composition to grape sugar, is also found in the healthy human body.

III. That both of these may be formed in the healthy human body.

Beyond these, certain other fairly definite propositions may be made.

[1] The discussion at length of the subject Glycogenesis, which formed part of the original article, has for want of space been here omitted.—ED.

1. Glycogen is found most abundantly in the liver, insomuch that, with due precautions, it can always be detected there: after a certain time sugar takes the place of glycogen, but the exact mode and time of this conversion are not known.

2. Nevertheless, it is fairly certain that the sugar called glucose can always be detected in the liver; still more certain that it is to be found in the blood; but

3. This sugar never appears in any notable quantity during a state of health in the urine.

4. As sugar is not to be found in any appreciable quantity in any other of the excretions, it follows:

5. That this sugar must disappear in the body.

6. It is commonly asserted, and, upon the whole, believed, that sugar is less plentiful in venous than in arterial blood.

7. From this, if true, it follows that sugar must be used up in the course of the circulation.

8. Where the combustion, or oxidation, occurs is not quite clear.

9. But it is plain that, from a fault in either direction, sugar may become over-abundant in the blood, namely:—

a. By over-production, or

b. By diminished consumption.

10. The over-production and the diminished consumption of sugar in the body may depend on various causes. The most notable of these are (*a*) an increased ingestion of saccharine material into the stomach and bowels, without a corresponding destruction; and (*b*) such an alteration of nerve-influence as will completely modify the relative proportions of the sugar produced and the sugar destroyed.

11. With an excess of sugar in the blood, only one easy road of egress from the body is available, that is, by way of the kidneys; but this is not a sufficient outlet when there is great superabundance in the blood. Sugar may then be found in almost every one of the secretions or excretions.

12. With this unnatural discharge of sugar there is usually a corresponding discharge of urine, but not always.

13. Thus there may be no greatly increased flow of urine, yet the urine may be rich in sugar.

14. And yet, again, there may be a copious flow of urine without any sugar, as in *Polyuria*.

15. Hence the over-production or the diminished consumption of sugar in the system has no necessary connection with increased flow of urine.

16. Both the abnormal action of the liver and that of the kidneys seem in the main to depend on similar but not identical causes.

17. Both seem to be under the control of the sympathetic, but the special fibres are not the same as regards the two organs.

(*a*) In the case of the liver the fibres seem to originate in the medulla oblongata, to descend in the spinal cord to the lower cervical or upper dorsal vertebræ, thence to leave the cord to join the gangliated sympathetic, and so ultimately to reach the liver.

(*b*) In the case of the kidneys the active fibres proceed further down the spinal cord, but are ultimately connected with the great abdominal plexus, for such it may well be called, whence the fibres proceed to the kidneys.

Ætiology.—The classification of cases of diabetes according to causation is in very many cases practically impossible.

As to the circumstances that call the morbid processes into play, we know very little. It is certain, however, that the disease is much more frequent among men than among women, and among the middle-aged than among the very young or the very old. The disease is very much more fatal in young adults than in those over, say, forty-five. That the disease is more rife in certain districts than in others may probably be best explained by its undoubted tendency to heredity. This heredity, as in many other maladies, is peculiar; the diabetic tendency in one branch of a family being represented in another branch by various nervous disorders, especially epilepsy and imbecility.

Of the so-called *exciting* causes there are two of the first rank, namely, injury, or disease of the brain; and mental excitement, or, perhaps still more, worry. Tumours and other local brain-mischiefs sometimes give rise to a fatal diabetes. Certain mental emotions, at once powerful and prolonged, which may be epitomised in the single word strain, apparently act as exciting causes of diabetes, such as continuous anxiety, long-lasting grief, or excitement followed by reaction. Certain errors of diet—such as excessive use of hydrocarbons, especially sugar—or other interference with the laws of health, may originate a fatal diabetes, especially in those who have any hereditary tendency to the disease. It is possible that the frequency of the malady among the Jews (as noted by Seegen) may be accounted for on dietetic grounds.

Anatomical Characters.—Many pathological conditions have been recorded as occurring in those who had been the subjects of diabetes, but we know little of its real pathology. In many cases nothing which can be directly connected with the diabetes has been found *post mortem*. Latterly attention has been mainly directed to the investigation of certain parts of the nervous system and of the liver itself. Perhaps the most reliable data for the ordinary anatomical appearances are to be found in Seegen's analysis of Rokitansky's experience, embracing 30 necropsies.

Connected with the *brain and spinal cord* various lesions have been found, such as tumours of different kinds pressing on the medulla, and softening, with or without the marks of extravasated blood. In some cases extravasation has been the only morbid change discovered. In two cases under the writer's care there were extravasations of blood in the spinal canal in the cervical and upper dorsal regions, and the same was observed in another case under the care of a colleague. In one of these there was very marked softening of the cord in the regions named. In these three cases death took place suddenly. Dr. Dickinson's theory of the origin of diabetes in lesions of the nervous system, represented by enlarged perivascular spaces, the sites of existent or pre-existent extravasations of blood with destruction of the surrounding nerve tissue, is hardly tenable. The exploration

of the sympathetic system has not been more satisfactory.

Rokitansky found (in 15 out of 30 cases) that the *liver* was enlarged, hyperæmic and hard, of a dark-brown colour, with its acini imperfectly defined. The same conditions were present in the cases examined by the writer. When the disease has lasted a long time, the liver may be smaller than natural. The same would appear to hold good with regard to the cells themselves. Early in the disease, the cells, especially in the outer portions of the acini, are large, plump, and rounded, instead of angular, with large and distinct nuclei. They tend to assume a wine-red colour with solution of iodine, from the presence of unchanged glycogen. There are also sometimes found signs of active cell-growth at this early stage. Later the cells seem smaller, and as if undergoing pigmentary degeneration.

The condition of the *pancreas* in diabetes is highly interesting. In 13 out of Rokitansky's 30 cases, it was strikingly small, hard, and bloodless; and in many cases it has been found so shrunken and altered as to be hardly recognisable save by its connections. Such was the case in one instance the writer has seen, and in all his other cases the pancreas has been abnormal, usually contracted here and there, hard and knotty. In one case, however, the organ was enlarged and more succulent than usual, probably the first stage of the mischief. The occurrence of so important pancreatic changes in about one-half the cases of diabetes would seem to indicate more than a casual connection with the disease. What this connection really is remains unascertained. Klebs has associated the changes with disease of the cœliac plexus. One result from the pancreatic mischief is inability to digest fat. This was seen in one of the cases referred to above.

The *kidneys* Rokitansky found diseased in 20 instances, but the changes were not uniform. Usually they presented the ordinary indications of hyperæmia, being enlarged, dark red, and full of blood. Occasionally there were signs of more extensive mischief, the substance of the kidney as well as its vessels and epithelium being involved, and the organ harder than natural. Often fatty changes occur. In one case of the writer's amyloid changes had begun in the Malpighian bodies.

The *lungs* are frequently diseased: in only 7 of his cases did Rokitansky find them normal; Dickinson only twice out of 27 instances. The changes included all stages, from acute or chronic pneumonia, to the formation of numerous cavities, or even to gangrene. In one of the writer's cases the whole of the upper lobe of one lung was converted into a huge cavity filled with solid and semi-fluid detritus, having no gangrenous odour. There had been no expectoration, and no hæmorrhage, though vessels were exposed.

The *stomach* and *intestinal canal* present little beyond the ordinary signs of recurrent or chronic catarrh—thickening, mammillation, and slaty pigmentation; erosions and ulcerations may, however, occur.

Symptoms.—The following sketch comprehends the more characteristic clinical features of diabetes; but there are often important variations in individual cases, though a certain number of features are common to all:—The patient, most likely a male between twenty and forty-five, when he comes before the physician has in all probability been suffering from the disease for some time; for it usually comes on insidiously. He may say that he has been in failing health for a varying period; that he has been very thirsty, and has passed much water, having to get up repeatedly for this purpose during the night. His appetite has been more than hearty; but his food seems to do him no good, for he has been constantly growing thinner, and he feels weak and ill. On closer examination it is found that he is daily passing as much perhaps as eight, ten, or more pints of urine, light in colour and of a peculiar sweetish odour, of a high specific gravity, perhaps 1040, and containing an abundance of sugar. The skin is dry and harsh; the tongue red and glazed or slightly furred; the mouth dry and clammy; the lips teeth, and gums are covered with scanty, sticky mucus; the breath is often sweetish, or it may be unpleasant from the state of the mouth; the bowels are confined; and the countenance wears an expression of weariness and fatigue.

From this point the malady may progress in one or other of two directions. Under judicious management the symptoms may ameliorate. Often the first indication of improvement is a copious perspiration; the thirst diminishes; less urine is passed; the appetite is not so ravenous; the sugar decreases in quantity; and with it the specific gravity is lessened. Emaciation ceases, and the patient begins to regain weight. This auspicious commencement may, with time and care, end in a more or less complete return to health. Unfortunately there is another side to the picture, for notwithstanding all our efforts the patient often goes from bad to worse. We fail to reduce the quantity of sugar beyond a certain point. The appetite gets more and more voracious, especially for starchy articles of food, for which the patient will sometimes lie, steal, do anything, and yet there is often no feeling of satiety. Sometimes the appetite fails, and then emaciation goes on still more rapidly. All sexual power and feeling have long ago been lost, the testes sometimes undergoing almost complete atrophy. The harsh, dry, and itchy skin becomes the seat of boils, or even of carbuncles. Often the sight is injured by cloudiness of the refractive media, especially of the lens, or by other and more anomalous changes. All this time the temperature is low, perhaps sub-normal; but towards the later stages of the malady it often rises. Such a rise indicates the accession of a formidable complication which might almost be said to be the natural termination of diabetes. This superadded mischief is a peculiar insidious kind of pneumonia, resembling acute pneumonic phthisis, and giving rise to local signs resembling those characteristic of that malady. The progress of this lung-mischief is rapid, the fever increases, and often there is irrepressible diarrhœa, sometimes of fatty-looking matter. As the end approaches, the sugar usually disappears from the urine, which may become albuminous and scanty. There may even be some œdema of the extremities. The end

often comes swiftly, and without warning, by acute pneumonia, or by what, for want of a better name, we call diabetic coma, or more slowly by gradual exhaustion. After the onset of pulmonary symptoms it is never very long delayed. Such may be said to be the ordinary course of a well-marked case of diabetes. There are cases slighter, where the history is different; but in both sets of cases there are certain symptoms, which demand further consideration than has been given them above.

The Urine.—The characteristic of the urine in diabetes is the presence in it of sugar in notable quantity, though this varies greatly in different cases. In the earliest and slightest forms of diabetes, small quantities of sugar may be passed now and again, as after a meal or the consumption of an unusual quantity of starchy or saccharine food; but the sugar may completely disappear in the interval, or may do so finally by the use of an animal diet. The sugar thus excreted is glycose of the kind called dextrose, from turning polarised light to the right, is readily soluble in water and alcohol, and easily ferments. When diabetic urine is allowed to stand in a warm place, fermentation soon sets in, gas being disengaged, and yeast deposited at the bottom of the vessel. The proportion of sugar to urine is usually from 8 to 12 per cent., but varies; the total quantity passed amounting to 20 or 25 ounces, or even more. Its presence in such proportion causes an increased specific gravity, though this is not invariably the case, inasmuch as it may vary from 1,008 to 1,060 or 1,070. Along with the presence of sugar, we almost invariably find an increase in the quantity of the urine. But neither is this an invariable feature of diabetes, for sugar may exist with a normal quantity of urine, constituting the so-called *Diabetes decipiens*. But in most cases, there is a marked increase, the quantity passed amounting to 8, 10, or 15 pints daily; and even the highest of these rates has been greatly exceeded. With an excessive amount of urine, its colour becomes lighter; sometimes it has a faint greenish tint, and when passed is quite clear. On standing there is no ordinary sediment, though, as already said, sporules of yeast may be deposited after a time. There is on the whole an excess—sometimes a large excess—of urea, and if the quantity of urine passed be small, urates or other urinary ingredients, as sulphates and phosphates, may appear. Very great inconvenience may arise in diabetic females, or even in males, by the arrest of saccharine urine about the external genitals, producing a raw or eczematous condition of the inside of the thighs and groins. The urine being also almost invariably acid, is highly irritating to the raw and swollen parts. Enuresis is common, especially at night, and among diabetic children. Albumen makes its appearance sometimes in the progress of, or in the later stages of the disease.

The Digestive Organs.—As the correlative of the unusual flow of urine we have also, as a marked and early symptom of diabetes, extreme thirst, a thirst too which cannot be satisfied, for apparently the more the patient drinks the greater is the thirst. This sensation is in some part due to the dry and clammy condition of the mouth, which it is difficult to relieve. Hunger, or even a voracious desire for food, is usually a prominent feature in diabetes, but is not invariably present, and in the later stages there may be complete loss of appetite, amounting to a loathing, especially for a restricted diet. It is often impossible to satisfy the intense craving for food, and should satiety be attained the sensation lasts but for a little time. The mouth is usually dry and parched, the saliva being scanty and tenacious. Often particles of food are retained about the teeth, and there putrefy, giving rise to unpleasant odours. The buccal fluid is almost always acid instead of alkaline, probably from the formation of lactic acid. The tongue is rarely perfectly natural. Seegen describes it as usually thickened and increased in volume, with fissures and glazed blood-red islands on its surface, which, however, may present a general coating. The teeth often fall out without pain from the retraction of the gums, and are singularly liable to caries. Digestion is usually good, except during catarrh of the stomach, which is a rather frequent condition. Constipation is the rule in diabetes, often to a troublesome extent. This arises partly from the deficiency of water in the bowel; partly also from the small quantity of fæcal residue from an exclusively meat diet. Diarrhœa, on the other hand, is not uncommon, and rapidly deteriorates the patient's strength.

General Symptoms.—Emaciation is an early and marked symptom of diabetes, but not invariably so, for diabetes often occurs and persists in stout persons, without removing the obesity. These are cases of the more tractable kind, the patients being usually somewhat advanced in life. Their complete cure is seldom effected, but they do not seem to suffer greatly from the malady. Though the emaciation is in great part due to the removal of fat, and in part to the abstraction of water from the tissues, there seems to be also an actual waste of muscular substance, especially in the advanced stages of the disease. With this emaciation are associated weakness, weariness, and disinclination to exertion. These are often among the earliest symptoms of the disease, and may occur long before wasting is noticed, and increasing markedly towards the close of the malady. From various causes, one being, doubtless, weakening of the heart, œdema of the lower extremities may occur, with or without albuminuria. Gangrene of the extremities, of the senile kind, has been observed.

Respiratory apparatus.—With regard to the respiratory organs, a peculiar apple- or hay-like odour of the breath is sometimes observed, probably arising from the production of acetone mixed with alcohol. But the most serious pulmonary symptoms are those of phthisis, resulting from a more or less chronic pneumonia. This mischief is usually indicated by a nightly rise in the temperature, but otherwise may remain for a time almost latent. It is most common in the young, and towards the end of the disease. The expectorated matters may contain sugar. Gangrene of the lung, or a form of necrosis of the lung-tissues, has been noticed. With this form of gangrene the sputum may be odourless.

Skin.—The skin is usually dry and scurfy, often

extremely itchy; wounds inflicted by scratching heal with difficulty. Copious saccharine sweat is observed in a certain number of instances. There is a marked tendency to the formation of boils and carbuncles. Boils often occur early in the disease, and may give the clue to the existence of diabetes. Carbuncles occurring late in the disease may be the immediate cause of death.

Nervous System and Special Senses.—The sight is often affected in diabetes, most frequently by the formation of diabetic cataract. Operations in such cases do badly till the disease is cured, and are seldom tried, for the cataract occurs late in the disease, and advances rapidly. A form of retinitis not unlike that of albuminuria is sometimes found. Other forms of imperfect vision of uncertain origin occur in diabetes. They go by the general term of diabetic amblyopia.

Along with the physical, the mental powers fail, and all moral sentiments become blunted, which, to the friends of the patient, is not the least distressing feature in the malady.

Genital organs.—Early in the history of the disease, all sexual appetite disappears, and sexual power soon fails in the male—but with improvement this may return. In the advanced stages amenorrhœa is not unusual amongst females.

Complications.—Several of the symptoms just described are regarded by some authorities as complications of diabetes rather than as belonging essentially to the disease. Such are especially diabetic cataract and amblyopia, boils and carbuncles, and the chronic pneumonia or phthisis in which diabetes so frequently ends. Gangrene of the extremities has also been occasionally observed. Amongst the intercurrent diseases that are specially to be watched for and seriously regarded, one of the most important is albuminuria, the appearance of which may encourage a false prognosis, from the fall in specific gravity of the urine that attends it.

Diagnosis.—The diagnosis of Diabetes depends on the discovery of sugar, in notable quantity, in the urine of the patient. But before the investigation for sugar is undertaken, there have usually been observed by the patient some of the early indications of diabetes, of which the following are the most frequent, though no one definite symptom invariably heralds the disease:—1. dryness of the mouth and thirst; 2. bodily weakness and gradual emaciation; 3. dryness of skin, with itching and a tendency to successive crops of boils; 4. urination in increased quantity, the urine being of a greenish yellow tint, with the odour described; 5. defects of vision. Occasionally the attention of the patient is drawn to the state of his urine by the attraction it presents to ants, flies, and other insects; or by the formation of white spots of sugar on his dress or boots left by the urine on evaporation.

We must not forget that in true diabetes we find sugar in notable quantity. There are often present in the urine other reducing agents (such as uric acid and colouring matters), so that the amount of sugar detected must be such as to admit of no doubt whatever. Again, the presence of the sugar must be persistent, hence a single examination will not suffice for diagnosis unless sugar be found in large quantity. It may so happen that the patient when seen is not passing sugar, from the influence of restricted diet, or from some other cause, such as pneumonia or other feverish condition. It is then best to examine the urine passed an hour or two after a meal, or even to permit the use of starchy food for a day or two, so that the constitutional proclivities of the patient may be the better ascertained. To determine the existence of sugar is not enough; it is always necessary to determine the quantity passed, so as to obtain a clue to the intensity of the disease, and to judge of the effects of treatment.

Qualitative testing for sugar.—1. *Specific gravity.*—This almost invariably exceeds that of the healthy secretion. If a large quantity of urine is being passed daily, the specific gravity of which is upwards of 1030, we have good *primâ facie* grounds for concluding that sugar is present. But as urinometers are often inaccurate, this criterion is of doubtful value.

2. *Formation of torulæ.*—When saccharine urine is allowed to stand for a time in a warm place, sooner or later fermentation is set up, with the formation of yeast-fungus (*Torula cerevisiæ*). The detection of the fungus by means of the microscope has been proposed as a test of the saccharinity of the urine. Such a test is of little use, for the spores of the ordinary mildew fungus (*Penicillium glaucum*) can hardly be distinguished from those of the yeast-fungus, and penicillium will grow on any decomposing organic matter.

3. *Fermentation.*—The fermentation of saccharine urine may be greatly accelerated by adding to it some fragments of dry German yeast, and placing it in a moderately warm place. The production of alcohol and carbonic acid which results is a certain test of the presence of sugar in the urine. This procedure, however, takes some time and is not very delicate, requiring about five parts of sugar in a thousand, or two and a half grains to the ounce, to give any satisfactory result. It is best managed as follows. Take a large test-tube, or ordinary medicine-bottle, place in it some fragments of yeast, and fill up with urine. Fit a cork with a hole bored through it with a bent glass tube, one end of which will reach nearly to the bottom of the bottle that is to contain the urine. Fix the cork firmly in the mouth of the bottle, so that the bent end of the tube shall turn away from its side, and over a wine-glass or similar collector. When fermentation begins, the carbonic acid collecting in the top of the bottle will press downwards on the fluid, which will thus be forced up through the bent tube, and fall into the wine-glass or other receiver. An important and valuable modification of this test will be noted hereafter.

4. *Moore's test* or *Heller's test.*—When saccharine urine is boiled with liquor potassæ the sugar is decomposed, and a compound is formed, giving its colour, black or brown, to the fluid. A convenient test-tube is filled one-third full with the urine, and an equal quantity of liquor potassæ is added. The two should then be well mixed by shaking, and the heat of a spirit lamp applied to the upper portion of the mixed fluids. If sugar be present this portion will gradually darken, the tint assumed varying in depth according to the quantity of sugar present. This test is very convenient, but it is liable to several objections,

notably these:—(*a*) It is far from delicate, requiring as much as three parts in a thousand, or a grain and a half of sugar to the ounce, to afford any satisfactory indication. (*b*) It is practically useless for quantitative purposes, though the plan has been tried of comparing the colour produced with the colours of solutions containing known quantities of sugar, as is done in the Nessler process for substances producing ammonia and its allies. (*c*) It is liable to two notable fallacies. (1) High-coloured urine is always darkened in tint, sometimes blackened, by boiling with liquor potassæ. (2) Liquor potassæ very often contains lead, which is liable to be converted into black sulphide, when boiled with caustic potass, if albumen or any organic matter be present in the urine. The former of these risks cannot well be obviated. The latter may, by first testing the purity of the liquor potassæ, and keeping it in green glass instead of white glass bottles.

5. *Boettger's test* consists in the action of sugar as a reducing agent on bismuth. A small quantity of urine having been poured into a test-tube, an equal bulk of a solution of carbonate of soda (one part of crystallised carbonate of soda to three of water) is to be added, and a small quantity of the ordinary basic nitrate of bismuth introduced. The whole is to be heated, when the appearance of a grey or black colour will indicate the reduction of the bismuth, and the presence of sugar. Albumen in the urine gives rise to a similar fallacy as in the last test, by the formation of a black sulphide of bismuth. Other metals, as silver, chromium, and tin, may be reduced in like manner, but by far the most convenient practically is copper, which is now almost universally employed for this purpose, as in

6. *Trommer's test.*—The usual mode of procedure is to take a drachm or two of urine in a test-tube, to add to it a few drops of solution of sulphate of copper, then to add liquor potassæ in excess, and to boil. When sugar is present a red or orange-coloured deposit of suboxide of copper should be thrown down. To this simple mode of testing there are several objections. If excess of copper be used some of the blue hydrated oxide of copper may remain unchanged, and so give rise to confusion. If too much liquor potassæ be used it may blacken the sugar. Hence it is better to add the liquor potassæ first, then to add the copper solution drop by drop. A bluish-white precipitate forms, which dissolves on shaking. In this way a splendid blue fluid is produced. When the precipitate ceases to dissolve, neither reagent can be in excess, and heat may be applied. This solution of the blue precipitate is due to the presence of sugar, but many other organic substances have the same effect. Among the substances which possess this property, yet do not reduce the copper by boiling, is tartaric acid, and advantage of this has been taken for the production of a test-fluid not open to the above objections. The employment of this is known as

7. *Fehling's test or method.*—This testing fluid may be procured ready-made, but the following is the formula for it, as slightly modified by Pavy, and fitted for daily use:—Five grains of sulphate of copper, ten grains of neutral tartrate of potash, and two drachms of liquor potassæ. A more exact formula will be given farther on. The fluid thus formed is of an intense blue colour, clear and bright. When the test-fluid is to be used, a small quantity of it should first be raised to the boiling point, because by prolonged keeping the tartaric acid undergoes change, a substance being formed from it which is capable of reducing copper, and might give rise to confusion. But if on boiling the test-fluid no copper is thrown down, the suspected urine should be added drop by drop, the mixed fluid being at the boiling point. If sugar be present in quantity it will throw down the copper in the form of a red or orange precipitate. The quantity of urine added must never exceed the bulk of the test-fluid, and the upper portion of the fluid should be heated, so as to contrast with the lower portion. Should suboxide of copper be thrown down when the test-fluid is boiled, the fluid must be filtered before adding the suspected urine, or, still better, a new fluid be prepared. To obviate as far as possible such inconveniences, the cupric and alkaline fluids should be kept in separate bottles until about to be used.

When the quantity of sugar in the urine is very small, as may occur in ordinary diabetes after long fasting or the use of a rigidly restricted diet, or during an access of fever, still more minute precautions must be taken. When, from any cause, the sugar present is less than three parts in a thousand, various anomalies may occur in the reaction. It is in such cases that the reducing power of uric acid and the urinary colouring matters assumes importance. With this small quantity of sugar the copper deposit is never red, but yellow; and we may have apparently any intermediate shade of colour from the deep blue of the copper solution through all varieties of green to yellow, with or without deposit after standing. Again, if the urine contains much phosphates, boiling with the alkaline solution may throw them down, and if at the same time the normal urinary constituents reduce some of the copper, the precipitate may roughly resemble a deposit of copper produced by sugar. It may thus be necessary to decolorise the urine, which may be done by passing it repeatedly through a filter of animal charcoal. Another difficulty is the presence of albumen in the urine, which renders the test nugatory. Accordingly in all cases, before applying any kind of test, the albumen must be removed by boiling and filtration.

Quantitative Testing for Sugar. 1. *Fehling's volumetric method.*—This method, now in common use, is founded on the fact that the proportion in which sugar reduces copper is constant. One equivalent of grape sugar decomposes exactly ten of sulphate of copper, or 180 parts by weight of grape sugar decompose 1246·8 parts by weight of sulphate of copper. This being borne in mind, and a copper solution of known strength being used, it is easy to determine the quantity of sugar in any given specimen of urine. The quantities may be calculated according to the metric system or by grains and minims. If we adopt the metric system, our fluid will consist of the following ingredients:—

Sulphate of Copper (crystals) 40 grammes.
Tartrate of Potass (neutral) 160 grammes.
Liquor Sodæ (Sp. gr. 1·12) 750 grammes.
Water to 1154·5 cubic centimetres.

These should be carefully mixed, or, what is better, the copper and alkaline solutions made separately, so that five cubic centimetres of each, or ten of the mixed fluids, will exactly decompose ·05 gramme or 50 milligrammes of sugar.

According to the English system of measurement, Dr. Pavy's solution is the most convenient. It consists of sulphate of copper, 320 grains, dissolved in ten ounces of distilled water; and tartrate of potash (neutral), 640 grains, with caustic potash 1280 grains, also dissolved in ten ounces of distilled water. These fluids may be kept separately or mixed. In mixing, the copper should be added to the alkaline solution, not *vice versâ*, to prevent the formation of any precipitate. One hundred minims of this mixed fluid are decomposed by half a grain of sugar. Only a minim measure and a porcelain capsule or other vessel, which will stand heat, are required for Pavy's solution in the procedure which is as follows:—Most specimens of diabetic urine, containing too much sugar for accurate testing, first require dilution with water, and the most convenient degree of dilution is when one-tenth of the fluid is urine. Next put ten cubic centimetres of the metric copper solution, or one hundred minims of Pavy's solution, carefully measured, in a small porcelain capsule. The fluid being deep blue is better for dilution, so as to diminish the intensity of tint. Of course this does not alter the quantity of copper present in it. The porcelain capsule with its contents is to be placed on an iron retort-stand, at such a level that the flame of a spirit lamp will easily play on the capsule. Meanwhile a pipette, graduated from above downwards, either in minims or cubic centimetres, is filled up exactly to the 0 in the graduated scale with the diluted urine. When the solution of copper is boiling, the urine is added to it from the pipette, drop by drop, stirring carefully the while, until signs are shown of a decoloration of the cupric solution. The moment all the copper has been thrown down as suboxide, and all shade of blue or green has disappeared, the addition of the diluted urine is stopped, and the quantity already used read off on the graduated pipette. To ascertain the quantity of sugar in the urine is now a simple calculation. We know how much urine has been employed in reducing the 10 cubic centimetres, or 100 minims of the cupric fluid, but these measures represent exactly 50 milligrammes and half a grain of sugar respectively. The quantity contained in the diluted urine being hence deduced, multiply this by ten, to get the quantity contained in the urine as passed. Next multiply by the total quantity of urine passed in twenty-four hours, to ascertain the full amount of sugar passed in this period. In all such analyses the sample examined should be taken from the mixed urine passed during the whole twenty-four hours. That passed at night is the richest, that passed in the morning poorest in sugar.

2. *Roberts' fermentation method.*—We have already noticed the fermentation method for demonstrating the existence of sugar in urine. Dr. William Roberts, of Manchester, has also devised from it a highly accurate quantitative process. It is as follows:—

Put about four ounces of the suspected urine into a clean eight- or twelve-ounce glass bottle. Introduce a piece of dry German yeast, about the size of the point of the forefinger, but divided into small pieces. Cork the bottle with a grooved cork to allow the escape of gas. Fill a companion bottle *quite full* with the urine. Cork quite tightly, and set both aside for twenty-four hours in a warm place—the mantelpiece will do. By the end of that time fermentation will probably have ceased, and the yeast fallen to the bottom; but if not, being suspended it will not affect the specific gravity of the fluid. The specific gravity of the two specimens must now be carefully taken with an accurate urinometer, that of the unfermented bottle being taken as the standard. The fermented urine will have lost weight from two causes. 1st, the sugar which gave the increased specific gravity has been destroyed; and, 2nd, in its place have been formed alcohol, which is lighter than water, and carbonic acid, which has escaped. *Every degree of specific gravity thus lost represents a grain of sugar in the ounce of urine.* Thus, if there is a loss of twenty-five degrees of specific gravity, the urine would contain twenty-five grains of sugar in each ounce. Multiply this by the total number of ounces passed, to get the amount of sugar discharged per diem. This plan is especially useful for noting the quantity of sugar passed day by day, and can be easily undertaken by the patient or his friends.

3. *Estimation by the polariscope.*—A plan of estimating sugar employed a good deal abroad, depends on the power of diabetic sugar to turn the plane of polarisation to the right. The degree of rotation is in proportion to the quantity of sugar contained in the urine. The apparatus used commonly goes by the name of the Ventske-Soleil apparatus, from its inventors. It is best adapted for light-coloured urines. If the urine be deep in colour it requires to be diluted.

4. *Estimation by specific gravity.*—The rudest mode of estimating sugar is by the specific gravity of the urine. Since the methods described above were introduced, there is no excuse for its employment save as a preliminary test, which may suggest the idea of sugar in the urine. To facilitate its use tables were drawn out, but the great increase of urea often found in diabetes renders the test of but little accuracy.

Prognosis, Course, and Termination.—The prognosis of confirmed diabetes is ever unfavourable. Amelioration is common, but a perfect cure, save in exceptional cases, is rare. Diabetes coming on suddenly and from special causes, such as injury to the head, is more likely to do well than when more gradually developed. The younger the patient, the more sugar passed the greater the emaciation and debility, the worse the prognosis. Diabetes persistent with pure flesh diet is worse than if persistent only with a free starchy or saccharine diet. Loss of appetite and of digestive power, as indicated by the condition of the fæces, is of evil omen. When albumen appears in the urine in the course of diabetes, the specific gravity of the fluid diminishes, often

giving rise to a false impression to the effect that, as the specific gravity has decreased, the diabetic state must be improved. The only true test of recovery is the power of consuming ordinary mixed food with impunity; but Seegen says that out of two hundred cases he had never seen this result. But by rigid or limited dieting, the patient may live, and even enjoy life, for many years. Heredity, directly or collaterally, adds to the blackness of the out-look. Cases resulting from injury to the brain or other parts of the nervous system are often the most hopeful with which we have to deal, though by no means always so. The course of diabetes is on the whole chronic. Most frequently it develops gradually, though in some cases suddenly, and it generally lasts from six months to three or four years. In stout elderly persons it may exist much longer, especially with good digestion and a limited dietary. On the other hand, Dr. Roberts records a case which proved fatal, after a well-marked onset, in eight days—the shortest period known to the writer. Another case was fatal in three weeks, the patient being three years old. Some cases are recorded of death at still earlier periods, but these were most probably cases of long duration in an unnoticed shape suddenly developed into an aggravated form. A fatal termination of diabetes may be brought about, as already indicated, in various ways. One is by diabetic coma, not unlike the first stages of uræmia. This may prove suddenly fatal, and has been described as due to fat embolism, or to acetone in the system. In the advanced stages of diabetes, the strength being very low, comparatively slight causes may produce fatal effects.

Treatment.—Though we are ignorant on many points as regards diabetes, yet when we come to its treatment, we have these undoubted facts—that sugar cannot be formed out of nothing; and that the series of substances out of which it may be formed is limited. And though we cannot absolutely succeed in feeding the patient on substances which will not yield sugar, we can supply a nourishing diet furnishing sugar-forming materials in the scantiest proportion—an end best attained by a pure meat diet. But besides dietetic measures, other, though subsidiary, means may be taken to limit the formation of sugar by suitable hygienic and medicinal treatment. It is convenient to treat of these separately, though they should be employed in conjunction.

Dietetic treatment.—All authorities agree that meat should be the main constituent of the patient's food, and that starch, and cane and grape sugar, should be avoided, as well as the substances containing them. The use of fats and oils, of fruit-sugar (levulose), and of milk-sugar, is not so definitely settled. Three of the ordinary constituents of meat—gelatine, glycogen, and glycerine—being sugar-formers, the parts of animals containing these should as far as possible be avoided. It is very important in constructing a diet scale to give the patient as much variety of form as possible, the basis remaining the same. As the diet of the patient is the main factor in his treatment, it is worth the practitioner's while to study the various changes and combinations of food which may be given with impunity. (See a long list of available dishes in the Appendix of Bouchardat's work on Diabetes.) As regards vegetables, the rule is that all green vegetables, or the green parts of vegetables, may be eaten; for where chlorophyll is abundant, starch and sugar are commonly scanty; but this rule has important exceptions, which will readily occur to the reader. Thus the green parts of asparagus and celery may be used, whilst the white portion is highly saccharine. Green artichokes may be used. Jerusalem artichokes are objectionable. Cabbage should be used before it forms a white heart. Cauliflower and brocoli are rather questionable. Scottish kale and spinach may always be used. Sea-kale is forbidden. Most fruits are forbidden, but nuts may be used if they can be digested. French beans may be used when quite green; when older the beans themselves must be removed. Haricot beans, peas, and all cereals; tapioca, sago, arrowroot, all forms of macaroni, potatoes, carrots, turnips, parsnips, and beetroot are in the forbidden list. Watercress, lettuce, and all kinds of green salad may be freely used. Cheese, especially of the poorer kinds, may be used. Cream, butter, and other fatty articles may be used in moderation, as they are only sugar-formers by virtue of the glycerine they contain. Some kinds of green pickle are useful; mustard pickle should not be used. Most mustard contains starch, but it may easily be got quite pure. To sweeten tea or coffee, mannite has been suggested; but both will soon be found more refreshing without sugar. Cocoa made from the nibs can be used. Small quantities of cold tea without milk or sugar, with slices of lemon in it, will often be found palatable, cleaning the mouth and relieving thirst. Rinsing the mouth with iced water will often give more relief than a hearty draught. Slowly sucking ice is a very good plan for relieving thirst. All sweet drinks are in the forbidden list, including most sherries and ports, though some of the former may be found nearly sugar-free. Nearly all brandies contain sugar. Light French and German wines contain little or no sugar. Gingerbeer and lemonade are very objectionable; so are champagne, sweet beer, cider, porter and stout, rum and gin. Whisky is probably the best form of spirits. The use of alcohol in these cases has been gravely questioned. Where alcohol has not been used before the onset of the disease, the patient is probably better without it; but it is quite clear that in many cases it may be taken in moderation with advantage.

There is difficulty in procuring a substitute for bread and potatoes. Three imperfect substitutes are employed, viz:—gluten bread, bran bread, and almond bread. Gluten bread as introduced by Bouchardat consists of flour out of which nearly, but not quite, all the starch has been washed. It is tough, and patients tire of it; a better form of gluten bread is made by Bonthron (Regent Street, London). This last is palatable and nearly starch-free, but does not keep well. Bran bread is now often made, in the form of biscuits or cakes; the bran should always be washed nearly free of flour. Bran bread is hardly admissible when there is a tendency to diarrhœa, but may be useful in constipation

Almond cakes were first introduced by Dr. Pavy. They are rather rich to be eaten with meat, but used by themselves or with wine are excellent. Almond flour may now be obtained from which much of the oil has been expressed.

We pass over Dr. Donkin's skim-milk treatment of diabetes with the remark that in the hands of Dr. Donkin and some others the method has been successful; in the hands of many eminent physicians, both at home and abroad, it has done unmitigated harm. Probably the explanation of any successful cases may be found in the fact, that in certain conditions of diabetes, milk sugar, as well as certain other substances, does not give rise to grape sugar. If milk is to be used, butter-milk or sour milk will be best. The treatment by sugar or glycerine is self-condemned.

Hygienic treatment.—In this the first and most important point is regular exercise, especially walking, not carried out to fatigue. Bouchardat has strongly advocated gymnastic exercises. These would be useful in moderation, especially in bad weather. Nothing is more grateful or beneficial to the skin after such exercise, or even without it, than a warm bath, temp. 80° to 90°, with a little common washing soda in it. In all cases, the avoidance of wet and cold is important. Flannels, frequently changed, should be worn; and it is always safer to change the clothes after the slightest exposure to damp. Little may suffice to give rise to a fatal pneumonia.

Medicinal Treatment.—This must be considered as subsidiary to dieting, but there are many cases where undoubted benefit results from drugs. Of those which have been found of real value, the foremost is opium. Yet there is no unanimity of opinion as to the mode in which opium acts, and its apparent effects are most discordant—in some cases reducing both sugar and urine without sleepiness, in others speedily giving rise to drowsiness and even apparently to coma. The varied susceptibility of different patients to this drug is very striking. Some will take 20 or even 50 or 60 grains a day with no apparent physiological effect beyond slight contraction of the pupil; others again cannot endure even a few grains. The writer's experience is decidedly in favour of opium. Codeia has been strongly recommended by Dr. Pavy as being the influential ingredient in the raw opium. He begins with doses of half a grain. Next to opium come alkalies, and especially some alkaline waters. Alkalies themselves may be given in various forms—as cream of tartar to relieve thirst, as citrate or bicarbonate of potash, or, if there is a tendency to gastro-intestinal catarrh, as liquor potassæ, with or without a bitter. The waters in most repute in diabetes are those of Carlsbad, Vichy, and Vals. An annual visit to Carlsbad, with the rigid system of regimen and dietary carried out under the resident physicians, often suffices, with due care, to keep the patient fairly well for many years.

Lactic acid has been strongly advocated by Cantani. His results seem good, but he also makes use of a most rigid dietary. Dr. B. Foster records a case where acute rheumatism seemed to arise from the use of lactic acid. Pepsine and rennet have been used, but without real advantage.

Of secondary remedial agents, the three most important are strychnine, iron, and cod-liver oil; these favour nutrition, and the cod-liver oil seems to improve the temperature somewhat. Laxatives, not purgatives, should be used for the troublesome costiveness. Mineral waters, castor-oil, or alkaline purgatives suit best.

Management of a Case of Diabetes.—By way of recapitulation we may say a few words here on the management of a case of diabetes. When a patient comes under the care of the practitioner he must first ascertain the general state of the patient as a basis for future comparison. The patient's weight must be carefully taken, and the state of his bowels noted. The quantity and characters of urine passed should be noted daily for a short time, the patient still consuming ordinary diet. After a day or two the restricted diet should be gradually commenced, sugar and potatoes being first cut off. Next the bread should go, being first of all cut down and used toasted hard or torrefied, and this should merge into the use of bran cakes or gluten bread. Above all things, the patient must not be disgusted with his food, for this favours the secret consumption of forbidden dainties. Week by week the weight should be taken; day by day the sugar estimated, as may easily be done by Roberts' method, and the whole arranged on a card so as to be seen at a glance. Warm baths, exercise, and the other adjuvants must be assiduously employed, and as soon as the effects of the limited diet are clearly marked, opium may be tried. If well borne it should be used determinedly, and pushed to its physiological effects, as indicated by the contracted pupil. If the patient is seen daily his diet should be regulated each day; if only at intervals certain available changes should be indicated. When convalescence begins, and the urine has for some time been free from sugar, the diet may be gradually relaxed, beginning with substances containing little starch or sugar, gradually extending to bread in small quantity; potatoes should come last, sugar itself never. When, with every care, restriction of diet effects no diminution of sugar, or, if that be limited, emaciation and weakness rapidly go on, it will be a question whether it may not be best, as it often is, to return to a practically unrestricted diet.

Alexander Silver.

DIAGNOSIS of Disease *See* Disease, Diagnosis of.

DIAPHORESIS (διὰ, through, and φορέω, I convey).—The act of perspiring. The term is more generally applied to perspiration artificially induced.

DIAPHORETICS (διὰ, through, and φορέω, I convey).

Definition.—Remedies which increase the secretion of sweat. When the increase is so great as to cause the perspiration to stand in beads upon the surface, they are usually termed *sudorifics*.

Enumeration. — The principal diaphoretic measures are—The Vapour Bath, Turkish Bath, and Wet Pack; Warm Drinks; Warm Clothing; Jaborandi, Pilocarpin; preparations of Antimony; Ipecacuanha; Opium and Morphia with their preparations; Sarsaparilla, Guaiacum, Serpentary, Sassafras, Senega, Mezereon, Camphor; Sulphur; Ammonia and its Carbonate, Acetate, and Citrate; Alcohol; Ethers (especially Nitrous Ether); and Chloroform.

Action.—The secretion of sweat usually consists of two parts, namely, a free supply of blood to the sweat-glands, and the abstraction from it of the materials for sweat by the cells of the gland. These two processes sometimes occur independently of each other. In fevers the supply of blood to the glands is abundant, but they do not secrete; and a similar condition is observed in belladonna-poisoning. Belladonna or atropia possesses the power of paralysing the secreting nerves of the sweat-glands, just as it does those of the salivary glands, and thus the skin remains dry, although the cutaneous vessels are much dilated. In collapse the cutaneous glands secrete a cold sweat profusely, although the supply of blood to them is deficient.

The secreting cells appear to be under the influence of nerves, by exciting which secretion occurs. The centres for the secreting nerves of the sweat-glands appear to be situated in the spinal cord, and in the medulla oblongata. The fibres seem to run in the same path as the vaso-motor nerves. The secretory nerves of the sweat-glands may be excited directly by a stimulation of the nervous trunks in which they run; and the sweat-centres may also be reflexly excited by irritation of various sensory nerves. Certain substances, such as nicotine and carbonic acid, seem to stimulate the sweat-centres; whilst other drugs, such as pilocarpin, appear to act upon the peripheral terminations of the secretory nerves in the sweat-glands themselves. Several remedies, at the same time that they excite secretion, likewise increase the flow of blood through the skin, rendering it redder, warmer, and more vascular. Others, again, excite the secretion at the same time that they diminish the cutaneous circulation. Diaphoretics have therefore been divided into two classes, the former kind being termed *stimulant*, and the latter *sedative* diaphoretics. The exact mode in which each drug already enumerated produces diaphoresis has not yet been ascertained, but antimony, ipecacuanha, and jaborandi are classed as sedative diaphoretics, and all the others as stimulating ones. The supply of blood and the secretion are both increased by the application of warmth, by the ingestion of warm fluids, and by the action of jaborandi.

Uses.—Diaphoretics are employed to increase the flow of blood to the surface, and possibly to aid the elimination of excrementitious products in internal congestion, such as catarrh of the respiratory passages or digestive tract, and in febrile conditions generally. In fevers, the cutaneous circulation is generally active, and the so-called sedative diaphoretics are then most useful. Diaphoretics are also used to increase the elimination of water by the skin, and thus lessen the accumulation of fluid in dropsy, or to relieve other excreting organs, such as the kidneys in albuminuria and diabetes insipidus, or the intestines in diarrhœa. In these cases stimulant diaphoretics are indicated.

T. Lauder Brunton.

DIAPHRAGM, Diseases of.—The diaphragm may itself be the seat of *functional disturbance*, or of *organic lesions*; or it may be affected by *neighbouring morbid conditions*. For practical purposes its affections may be conveniently discussed according to the following arrangement:—

1. Mechanical Interference.
2. Functional Disorders. (*a*) **Paralysis.** (*b*) **Spasm.**
3. Organic Lesions. (*a*) **Injuries,** including **Ruptures** and **Perforations.** (*b*) **Inflammation, acute** or **chronic.** (*c*) **Muscular Rheumatism.** (*d*) **Atrophy** and **Degeneration.** (*e*) **Morbid formations.**

1. Mechanical Interference.—The diaphragm is frequently interfered with by morbid conditions within the chest or abdomen, which impede its action, displace it more or less, either upwards or downwards, or render it tense and stretched. The entire structure may be thus affected, or only a portion of it, such as one lateral half or its central part. The chief thoracic conditions by which the diaphragm may be thus affected are pleuritic effusion or pneumothorax, emphysema of the lungs, abundant pericardial effusion, enlargements of the heart, and tumours within the chest. The principal abdominal conditions deserving notice as being liable to produce this effect are a distended stomach, tympanites, ascites, peritonitis, pregnancy, large fæcal accumulations, and tumours or enlarged organs which attain considerable dimensions, especially ovarian, hepatic, splenic or renal tumours. It sometimes happens that the diaphragm is interfered with both from its thoracic and its abdominal aspects.

The symptoms induced by this mechanical interference are readily explained by its effects. A sense of uneasiness and discomfort is often experienced around the lower part of the chest, amounting sometimes to considerable tension and tightness. There is not any actual pain, but in some instances, where the diaphragm is much pushed down, the patient complains of a painful sensation referred to the ensiform cartilage, as if the attachment of the diaphragm at this point were being severely dragged upon. The act of respiration is more or less impeded, and this often seems to be the cause of the discomfort experienced. A sensation frequently complained of by patients is that they cannot take a full breath. Respiration may be much hurried, or oppressed and laboured, and not uncommonly the normal relation between the thoracic and abdominal movements is markedly altered, as observed on physical examination, and the diaphragm may so act as to draw in the lower part of the chest-walls in inspiration. Occasionally a kind of spasmodic cough seems to be excited by the tension of the diaphragm produced by certain conditions. The act of coughing is also frequently rendered more or less difficult and ineffectual.

2. Functional Disorders.—The affections of the diaphragm included within this group are (*a*) **Paralysis**; (*b*) **Spasm.**

a. **Paralysis.**—The diaphragm is completely paralysed when the upper part of the spinal cord is destroyed, whether as the result of injury or disease. If one or both phrenic nerves should be cut across, or destroyed by disease, or even severely compressed, the same effect will be produced, either one lateral half or the whole of the diaphragm being paralysed, according as one or both nerves are involved. This structure may also be implicated in the course of diphtheritic paralysis.

Where paralysis of the whole diaphragm is suddenly produced, death speedily ensues from the grave impediment to the respiratory function resulting therefrom. If it is brought about gradually, or if only part of the structure is involved, the effects are seen in more or less interference with this function, and with the acts in which respiration is concerned. Thus there will be a subjective sensation of dyspnœa, and of a want of power to breathe; while the respiratory movements will be hurried, shallow, and superior-thoracic. Coughing cannot be performed efficiently, and sputa cannot be expelled, while the abdominal acts for which a tense diaphragm is required, such as defæcation or vomiting, are also ineffectual or impracticable. The lower parts of the lungs become more and more congested, fluids accumulate in the air-tubes and pulmonary vesicles, which become by degrees filled up, and the patient ultimately dies of asphyxia.

b. **Spasm.**—The diaphragm may be the seat either of clonic or tonic spasm or cramp. The disorder may depend upon disease of the nerve-centre at the origin of the phrenic nerves; irritation of these nerves in their course; direct excitation of the diaphragm; or reflex causes. Tonic spasm is most strikingly observed in cases of tetanus; of poisoning by strychnia, or of hydrophobia; but a form of asthmatic attack has also been attributed to this condition of the diaphragm.

The symptoms will vary in different cases. Tonic contraction of the diaphragm gives rise to severe pain, and a sense of constriction in the corresponding region, which may come on in paroxysms; clonic spasms also originate painful sensations after a time, which may become very considerable. Hiccup is probably due mainly to a clonic spasm of the diaphragm. If this structure should become rigidly fixed, respiration is gravely interfered with, and the patient soon presents the phenomena of suffocation, which will end fatally if the spasm is not relieved. In the form of asthma supposed to be due to diaphragmatic spasm, expiration is very difficult and greatly prolonged, inspiration being short and abrupt; the lungs are distended; great distress is felt; and there may be signs of impending death from suffocation. A spasmodic cough may be due to clonic spasm of the diaphragm.

3. Organic Lesions.—These may be briefly considered in the order in which they were enumerated at the commencement of this article.

a. **Injury, Perforation, and Rupture.**—The diaphragm may be perforated, lacerated, or ruptured in connection with various forms of injury, such as crushing accidents, fractured ribs, penetrating wounds, or gun-shot injuries. Should the patient recover, a permanent perforation may be left. In medical practice perforation of this structure may be met with as a congenital condition; as the result of the bursting of some fluid-collection through it, such as an empyæma, a hepatic, renal, or other abscess, or a hydatid-cyst; or from its destruction in the progress of some organic lesion, such as malignant disease or an aneurism. It may occasionally occur, independently of these causes, owing to the yielding of a weak portion of the diaphragm, especially between the attachment to the ensiform cartilage and the seventh rib. In rare instances the perforation is congenital, or a considerable portion of the diaphragm may be deficient. The size and other characters of the perforation differ much in different cases. If it is produced by the opening through the diaphragm of a fluid-accumulation, this fluid escapes from the abdominal into the thoracic cavity, or *vice versâ*; in other instances the portions of the thoracic or abdominal organs pass through the perforation, constituting forms of *diaphragmatic hernia*. The writer had the opportunity of observing a remarkable instance in which the entire stomach had passed through an opening in the diaphragm into the cavity of the chest. In a case reported by Dr. Little, of Dublin, the diaphragm presented an almost circular opening, well-defined, sharp, with somewhat thick edges, and through this opening passed a hernia consisting of peritoneum containing some omentum, and about fifteen inches of the transverse and descending colon.

To recognise clinically a perforation or rupture of the diaphragm is generally no easy matter. Often there are no symptoms referable to this structure, though there may be signs indicating that its functions are more or less impeded. The occurrence of sudden perforation may be known from the previous existence of some condition likely to cause this event, such as empyæma, or an abdominal abscess; the supervention of acute pain, accompanied with indications of shock or collapse, and the disappearance of the signs of the original morbid condition; and followed by the development of phenomena revealing that fluid has passed through the diaphragm, and accumulated in the thoracic or abdominal cavity, as the case may be, or that some secondary affection has been set up as the result of the perforation, such as peritonitis or pleurisy. A fluid collection may, however, penetrate the diaphragm without giving rise to any very evident disturbance. When an organ passes through the diaphragm, the symptoms present, if any, are more likely to be associated with this organ than with the diaphragm, and physical examination may possibly detect the displacement. In the case of hernia of the stomach, already referred to, the chief symptom was vomiting, which occurred immediately after taking any food or drink.

b. **Inflammation.**—The serous covering of the diaphragm, either on its thoracic or abdominal aspect, is not uncommonly involved in cases

of acute pleurisy or peritonitis respectively, and the inflammatory process may penetrate its structure. It may also be involved by extension from pericarditis. Inflammation of the substance of the diaphragm may further arise from injury, direct irritation, pyæmia, or without any evident cause. The anatomical conditions observed are increased vascularity; the formation of lymph upon its surfaces; softening and degeneration of its muscular tissue; or, in rare instances, suppuration, an abscess forming in the substance of the diaphragm, or pus collecting under one or other of its serous coverings. Chronic inflammation of the diaphragm may occur, leading to a fibroid change in its muscular portions, either by extension from neighbouring structures, or as the result of chronic local irritation.

The symptoms of acute inflammation of the diaphragm are generally very obscure and ill-defined. The condition may be indicated by severe pain in the region of this structure, obviously increased by breathing, so that the respiration becomes instinctively thoracic, as well as hurried and shallow; and also much aggravated by coughing, defæcation, or any other act which disturbs the diaphragm. The patient will probably be much distressed. More or less pyrexia will probably be observed. If an abscess should form, this might burst either into the chest or abdomen, and thus lead to secondary pleurisy or peritonitis. Chronic inflammation and its consequences may possibly be suspected from a want of free movement in the diaphragm, associated with conditions likely to originate this change; but it could scarcely be recognised with any certainty.

c. **Muscular Rheumatism.**—The diaphragm may be involved in this complaint, whatever its nature may be; probably it is attended with structural changes in its tissues. The affection is characterised by pain referred to the diaphragm, which may be very acute when it is in any way brought into play. So long as it is kept at rest, there may be no discomfort, but deep breathing causes considerable pain, so that the respiration is carried on in a shallow manner, and may be entirely thoracic. Such acts as coughing or defæcation cause much pain and a sense of aching.

d. **Atrophy and Degeneration.**—The diaphragm may be involved in the course of progressive muscular atrophy; it may also be atrophied from causes which produce general wasting; or undergo senile atrophy and degeneration; or be similarly affected from local causes, such as interference with its blood-supply from vascular degeneration, want of action, or after chronic inflammation. These conditions might give rise to more or less evident interference with the functions of the diaphragm, which in extreme cases would amount to their total cessation, diaphragmatic breathing being rendered impossible, the symptoms being then the same as when the diaphragm is paralysed. In cases of progressive muscular atrophy the fatal termination may arise from this cause. There would not be any pain, but uncomfortable sensations might arise from the impeded respiration.

e. **Morbid Formations.**—The diaphragm is occasionally the seat of malignant disease, being usually involved by extension from some neighbouring structure. Non-malignant solid growths have in rare instances been found in it. Parasitic formations may also occur in it, namely, hydatids, cysticercus, and trichina spiralis. Tubercle is occasionally found in the diaphragm. Possibly malignant disease might be indicated by signs of impeded diaphragmatic movements, with localised pain, accompanying indications of cancer in other parts. The implication of the diaphragm in trichinosis may also be recognised in some instances by severe pains, spasmodic contractions, and serious interference with diaphragmatic respiration. In most cases, however, the presence of any morbid growth in connection with the diaphragm cannot be diagnosed during life, and is only discovered at the post-mortem examination.

Treatment.—But little can be done in most cases in the way of direct treatment in connection with affections of the diaphragm. The most obvious indication is to get rid, if possible, of any condition which is mechanically impeding its movements, and preventing it from performing its functions. In the next place, any disease of which the condition of the diaphragm is but a part must receive due attention, such as progressive muscular atrophy, centric nervous disease, or trichinosis. Painful affections might be relieved by local applications of dry heat, fomentations, or anodynes; and if acute inflammation is suspected, a few leeches might be applied. Electricity might prove of service in the treatment of some cases of spasm or paralysis of the diaphragm, the continuous current in the one case, the interrupted current in the other.

Frederick T. Roberts.

DIARRHŒA (διαῤῥέω, I flow away). — Synon.: *Defluxio; Alvi Fluxus; Purging*; Fr. *Cours de Ventre; Dévoyement*; Ger. *Der Durchfall; Bauchfluss; Durchlauf.*

Definition.—A frequent and profuse discharge of loose or of fluid alvine evacuations, without tenesmus.

Ætiology. — The causes *predisposing* to diarrhœa are individual peculiarity; childhood —especially the period of first dentition; the climacteric period; and hereditary or acquired weakness of the digestive organs.—The *exciting* causes may be thus classified:—1. *Direct irritation of the intestines* by (*a*) *Food* in excess, or of improper quality—for example, salted meat, shell-fish, sour unripe fruit and vegetables—diseased, decomposed, or imperfectly masticated; the products of faulty digestion prematurely passing the pylorus; imperfectly elaborated and fermenting chyme; impure water, such as that containing from 3 to 10 grains of putrescent animal matter per gallon (Parkes); or imperfectly fermented malt liquors. (*b*) *Purgative medicines and irritant poisons.* (*c*) *Bile*, excessive or acrid. (*d*) *Fæces*, retained. (*e*) *Entozoa*—lumbrici, tænia, trichinæ, and *entophyta*—mycosis enteralis (Buhl and others). (*f*) The contents of a ruptured abscess or hydatid cyst. (*g*) *Intestinal lesion*—such as tubercular or other ulceration. 2. *Defective hygiene.*—Diarrhœa may arise from the dwelling being damp, cold, dark, and unventilated; or from foul emanations from decaying

organic, especially animal matter, sewage, or fæcal collections. 3. *Chills, climatic variations*, &c. Diarrhœa has been attributed to insufficient clothing; sudden exposure to cold and damp; chills, as from wet feet, and damp bed or clothing; over-heating, as by excess of bed-clothing; and rapid variations of temperature, such as hot days and cold nights. 4. *Nervous disturbances*, for example, depressing emotions—fright, grief; neuralgia, hepatalgia (Trousseau), dentition, and other causes of reflex disorder. 5. *Defective absorption with augmented peristalsis*, so that the food is passed unaltered—*Lienteric diarrhœa*. 6. *Symptomatic* in various morbid states, for instance, in passive congestion of the portal vein from disease of the liver, heart, or lungs; peritonitis, especially puerperal; organic disease of the intestines—ulceration (simple, typhoid, tubercular, cancerous), lardaceous degeneration, enteritis, acute or chronic; cholera; typhoid fever; dysentery; occasionally in pyæmia, measles, scarlatina, confluent small-pox, malaria, gout, Bright's disease (its later stages), and in anæmia and exhaustion, as from over-lactation, phthisis, cancer, Addison's disease, Hodgkin's disease, exophthalmic goitre, leucocythæmia, and other affections.

Frequently diarrhœa arises from the combined action of several exciting causes, as when the disease is epidemic during summer and autumn Foul emanations from decomposing organic matter, over-crowding, food (and especially fruit) in a state of incipient decay, excessive heat, and chills, may then collectively determine the result. In children the exalted irritability of the nervous system during dentition predisposes to diarrhœa from slight determining causes.

Description and Varieties.—Diarrhœa may be broadly divided into the *acute* or occasional, and the *chronic* forms; and the numerous clinical and pathological peculiarities of different cases are conveniently grouped into typical varieties. The general effects, varying according to the intensity and duration of the flux, are mainly these:—Emaciation, and, in children, also arrest of growth—the weight either diminishing or ceasing to be progressive; anæmia, indicating defective hæmatosis; desiccation of the tissues from the rapid draining of serum from the blood—hence the thirst, and the very concentrated, acid, and even albuminous urine observed when there is a copious watery outflow from the bowels, as in choleraic and similar forms of diarrhœa.

It will be expedient to describe briefly the principal forms of diarrhœa.

1. **Irritative Diarrhœa.**—Synon.: *Diarrhœa Crapulosa* (Cullen).—Simple flux from direct irritation of the intestines is the most common variety of diarrhœa. The evacuations, usually preceded by severe griping pains, are at first fæculent and usually fetid and sour, then watery. In children (especially hand-fed) they are often like pale clay or putty, or they contain dense masses of undigested casein before being loose; after evacuation they frequently become greenish, like chopped spinach, from contact with very concentrated acid urine converting the brown colouring matter of the bile into green biliverdin; or they are dark green when passed, and may be so acrid as to excoriate the anus, the genitals, the inner parts of the thighs, and even the heels. Fever is usually absent.

Diarrhœa from irritation is frequently a preliminary stage of the inflammatory, dysenteric and choleraic varieties.

2. **Inflammatory Diarrhœa.**—Synon.: *Diarrhœa Serosa.*—When the causes of simple irritation excite inflammation of the mucous membrane of the bowels, fever sets in, and the diarrhœa increases. Usually the evacuations become more serous, and contain shreds of fibrin or mucus or pus. Before the attack passes off the large bowels are apt to be the main seat of inflammation; then the motions are scanty, frequent, more mucous or glairy, contain streaks of blood and are passed with severe straining; while the skin is hot and dry.

3. **Choleriform Diarrhœa**—Synon.: *Choleraic diarrhœa; Thermic diarrhœa* — prevails mostly in hot weather. The onset, indicated by vomiting and purging, is usually sudden. At first the vomited matters are mucous and bile-tinted, and the dejections are feculent—both quickly, however, becoming more and more abundant, watery, and colourless. The copious and incessant outflow of serum may in a short time, and especially in children, induce a striking resemblance to the symptoms of Asiatic cholera—a drawn, sunken, and cyanotic appearance, loss of temperature, scanty secretion of urine, insatiable thirst, and cramps; even in extreme cases the fluids from the stomach and bowels are, however, rarely free from bile, and are not so like rice-water as in true cholera. The collapsed algid condition as a rule rapidly gives place to recovery in previously healthy adults, while it is fatal in delicate children, children prematurely weaned, the debilitated, and the aged. Rarely, the cold stage being outlived, the patient becomes hot, and passes into a state of stupor, with either bilious vomiting or purging and tympanites—the typhoid stage. In children death is almost invariable if the cold stage exceeds twenty-four hours.

4. **Nervous Diarrhœa.**—The peristaltic movements, and the activity of the glands of the alimentary canal, are often increased by causes operating through the nervous system. Diarrhœa from mental, and especially emotional, perturbation, is the most common example. Even a chronic looseness may be maintained by debility of the nervous system, induced by worry and anxiety. Exalted innervation of the bowels may be natural, a proneness to diarrhœa from slight exciting causes having always existed; or acquired, when, for instance, a flux once established is apt to be maintained. The unstable nervous system of the periods of rapid development and of the climacteric change predisposes to it. It is often an important factor in chronic diarrhœa. The intestinal nerve-centres may become so sensitive (as in delicate children) that every meal, however small, may induce an immediate call to stool, the motions being liquid or pultaceous, and pale, but otherwise healthy. The peristaltic movements may be even so increased as to hurry the food through the stomach and bowels, so that it appears unchanged in the stools. Time is not allowed for digestion or absorption to be even begun. This form has

been termed *Diarrhœa lienterica*, and is most frequent in children before the period of the second dentition. The increased tonicity of the muscular fibres of the alimentary tract may have resulted from previous inflammation of the mucous surface, or is the propagation upwards of some irritation (ulcer, inflammation, &c.) of the mucous membrane of the rectum; or it arises from the products of imperfect primary digestion entering the duodenum. In adults indigestion is the usual cause. The appetite is as a rule voracious, and debility may become extreme. In painful or difficult dentition, diarrhœa arises from irritation of the nerves of the stomach and bowels; digestion is arrested, and the contents of the alimentary canal become acid from fermentation, and are ejected by vomiting and purging.

5. **Vicarious Diarrhœa.**—Embarrassment or suppression of the functions of the skin, kidneys, or lungs may be met by the bowels performing additional excretory work. The flux thus set up is salutary, because it is compensatory. Diarrhœa from chills (suppressed perspiration) is a common instance, while that from renal and pulmonary causes is less frequently observed, and may be misconstrued by the practitioner. Inasmuch as diarrhœa usually diminishes the quantity of urine, even sometimes to the verge of suppression, the reverse of this clinical fact may be easily overlooked or misinterpreted. Even when forewarned, the observer may at times—especially when the urine is free from albumen—find it difficult to determine whether the diarrhœa is a cause or an effect of imperfect renal elimination—a distinction having all-important bearings on the treatment. The uræmic and eliminatory character of it may be easily decided when the kidneys are known to be diseased; not so, however, when the only thing ascertainable is scanty—maybe albuminous—urine, or total suppression of urine in an elderly patient. In such a case there may or may not be organic disease of the kidneys, and still the diarrhœa may be uræmic, inasmuch as it may depend on 'renal inadequacy.' Diarrhœa from pulmonary embarrassment generally affords relief to breathing and cough. The chronic looseness of some gouty patients is also eliminatory: when checked, gout is apt to advance and the health to suffer.

6. **Diarrhœa from mechanical congestion.**—Draining of serum into the bowels is a common result of overloading of the portal vein from an impediment to the flow of blood, either in the vein itself, the vena cava, or the right side of the heart.

7. **Chronic Diarrhœa.** Synon.: *Cachectic diarrhœa.*—Chronic diarrhœa is frequently, if not generally, unconnected with intestinal lesions; it may be maintained by chronic catarrh of the intestines, or by an exhausted and impoverished state of the system, as in inanition, either from insufficiency of food or from enfeebled digestion, or in chronic wasting diseases, such as syphilis, malaria, or scurvy. The flux increasing, the debility on which it depends thereby perpetuates itself, and this vicious circle tends more and more to destroy life by anæmia and exhaustion, and even after apparent recovery there is a strong disposition to revert to it. These clinical features of chronic diarrhœa are well illustrated by the malady which, from the paleness of the stools, is commonly known in India as 'White Flux'—a result of deterioration of health by climate and malaria. When accompanied by fever and night-sweats, chronic diarrhœa is nearly always due to tuberculisation.

Diagnosis.—The different forms of diarrhœa may be readily distinguished from each other by a careful consideration of the causes and symptoms. The diseases most apt to be mistaken for diarrhœa are epidemic cholera, dysentery, and mucous irritation of the bowels from retention of fæces.

a. Cholera, in its less definite forms, may resemble bilious diarrhœa and choleraic diarrhœa. The probability in favour of it may be determined by the absence of the ordinary causes of diarrhœa, the paleness and watery character of the stools, tormina being slight or absent, the suppression of urine, and the early exhaustion. The presence of bile in the stools is always in favour of diarrhœa. Vomiting is more frequent in cholera; when it occurs in diarrhœa the vomited matter usually contains bile and undigested food, while in cholera it is a colourless fluid.

b. Dysentery is usually characterised by fever, tormina, and tenesmus, and frequent scanty muco-sanguinolent evacuations. Sometimes, however, in the early stage, the motions are copious, watery, and fæculent, as in ordinary diarrhœa; but the presence of tormina and tenesmus, and tenderness in the regions of the cæcum and sigmoid flexure, indicate the dysenteric nature of the disease. Chronic diarrhœa may be distinguished from chronic dysentery by the absence of a history of acute dysentery, or of mucus and tenesmus, and the less frequent discharge of blood in the evacuations.

c. Mucous irritation of the bowels.—Retention of fæces may induce a condition resembling diarrhœa—frequent thin muco-fæculent evacuations, which are, however, shown on enquiry to be somewhat scanty, and voided with straining.

Treatment.—(*a*) *Diet and hygiene.* In *acute* or *occasional* attacks of diarrhœa, everything should be taken in small quantity, and tepid or cold, never hot. Farinacea—arrowroot, sago, rice, tapioca, flour, and the like are useful, and may be taken in milk, or in chicken or mutton broth, or weak beef-tea. Animal broths—and especially beef-tea—when concentrated, or in large quantity, are apt to aggravate diarrhœa. Mucilaginous drinks—white of egg in water or milk, rice or barley or arrowroot water; and astringent liquids—infusion of dried whortleberries or roasted acorns, red light wines—may be given. Brandy is often of service, and may be mixed with spices or with the farinacea. Lime-water with milk is in many cases of much value.

Rest in bed secures a uniform warmth of skin, and favours the cessation of diarrhœa.

In children, errors of feeding should be corrected. Lumps of casein in the motions may be met by reducing the quantity of milk, and regulating the time between meals, providing a wet nurse, or substituting the milk of the goat or ass for that of the cow. Sometimes, however, milk in any form must be given up. The abdo-

men should be protected by a flannel bandage, and the feet and legs by warm clothing.

Inasmuch as in *chronic diarrhœa* the flux is perpetuated by the debility and anæmia which it induces, and by the activity of intestinal digestion, it has become a leading principle of treatment to prescribe food rich in materials for the construction of the blood and the tissues, and almost wholly disposed of by the stomach. Hence the happy results frequently observed from a diet exclusively animal, either raw or lightly-cooked, the digestion of which may be aided by hydrochloric acid alone or with pepsin. Individual peculiarity may be gratified, and variety obtained from the use of mutton, veal, chicken, pigeon, and game. Beef, the tough parts of veal, and pork are, as a rule, to be avoided. Milk and farinacea are gradually permitted during the progress towards recovery, but the period during which they should be interdicted may require to be very prolonged—even months. The treatment by *raw meat*, strongly advocated by Trousseau and Niemeyer, has been successfully applied to nearly every variety of chronic diarrhœa, but especially to that obstinate one occurring from the time of weaning to the close of the first dentition. The meat may be pounded into a pulp or finely minced, then mixed with salt, sugar, fruit jelly, or conserve of roses, or diffused through clear gravy soup or chocolate made with water or wine; or the juice may be extracted from it by pressure. Notwithstanding the prohibition of other food, it is best to begin with a small quantity, and to increase it gradually. The only drink allowable is water containing white of egg. Trousseau found opium in small doses, chalk, and bismuth, at and between meals, to assist this regimen. When a restricted animal diet cannot be digested, causes loathing, or aggravates the flux, other varieties of food may be added, and the feeding should be as generous and varied as possible, and adapted to the digestion of the individual. Articles of diet appearing undigested in the motions should be avoided. Low and damp situations should be exchanged for dry and open ones. Warm clothing, flannel next the skin, and flannel waistbelts should be worn.

(*b*) *Medicinal Treatment.*—The kind and degree of interference required should first be decided in each case of diarrhœa. A routine prescription of astringents is much to be deprecated. When the flux is moderate and salutary—for example, removing undigested or indigestible materials or irritating secretions, relieving an engorged portal vein, or supplementing a suppressed secretion—it may be left uncontrolled by medicine, or may be encouraged by laxatives, such as castor oil, rhubarb, or a saline aperient, combined with a mild sedative—for instance, henbane or opium: it cannot be checked without risk. As a rule, the treatment of diarrhœa should begin by removing irritating substances from the alimentary canal by aperients guarded by small doses of opium; and astringents, such as chalk-mixture with kino, catechu, hæmatoxylum, and opium, should be held in reserve. A purgative may increase the flux, which, however, soon subsides. Trousseau advocated the use of salines—sodæ sulphas, soda tartarata, magnesiæ sulphas—in progressively decreasing doses, dissolved in a small bulk of water, in the morning fasting, while others prefer castor oil, rhubarb, or other aperients. Castor oil is by far the most useful remedy for children, as well as for adults; for the former it should be emulsified in gum and syrup, and for the latter in yelk of egg, and as occasion requires combined with a small opiate, for example, compound tincture of camphor, vinum opii, or tincture of opium.

In *choleraic diarrhœa*, the best results are obtained from castor-oil guarded by a small dose of laudanum at the commencement, and repeated if the disease is severe; while astringents and opiates alone are withheld until the bowels are relieved of offensive materials, as in the later stages, the stools being copious and watery, griping and distension of the abdomen absent, and the tongue clean. Vomiting should be encouraged by copious draughts of warm water, and, if need be, by emetics of mustard or ipecacuanha. In children, when the motions are colourless, profuse, and incessant, it is best to give hydrargyrum cum cretâ in small doses every hour or two, and a very small enema of starch, containing phumbi acetas or cupri sulphas, with laudanum, which may be repeated if necessary; and the urgency of the case may likewise demand a firm astringent, such as logwood. In the cold stage there have been recommended mustard baths (for twelve or fifteen minutes, several times a day); emetics (ipecacuanha 2 to 3 grains twice or three times in twenty-four hours); diffusible stimulants (ether in syrup every hour or half-hour); and mercurials (hydrargyrum cum cretâ); in the stage of reaction, saline aperients or calomel in small doses throughout, white-of-egg in water as a drink; and, vomiting having ceased and diarrhœa being established, bismuth, chalk, and lime water.

In *nervous diarrhœa* the first indication is to allay reflex excitability by the bromides, or, these failing, by opium. When diarrhœa is excited by food, the dose should be given shortly before meals. In *lienteric diarrhœa* arsenic is invaluable. Mal-digestion should be met by hydrochloric acid, bismuth with alkalies, or other appropriate remedies, according to the indications. Occasional doses of castor-oil—alone, or with bismuth or small doses of opium or henbane—are useful in clearing away fermentescible matters, which are apt to maintain an irritable state of the bowels. Astringents should only be prescribed after the failure of these or similar measures.

In *vicarious diarrhœa* the skin should be made to act freely by warm baths, or hot air or vapour baths. In renal inadequacy counter-irritation across the loins, digitalis, and nitrate of potash may be likewise indicated. The diarrhœa should not be arrested or even checked unless it be profuse and exhausting, especially after restoring or augmenting the action of the skin and the kidneys; it is sometimes advisable to nurse and encourage it.

Diarrhœa from passive congestion of the portal vein is to be met by treating the cause, for example, disease of the heart, by digitalis, iron, and other remedies.

The flux of *chronic diarrhœa* cannot as a rule be stopped altogether by astringents only—the evacuations while thus retained may decompose, and induce flatulence and colic, or fever. The general health should be restored and anæmia removed; the secretions will then generally improve and the diarrhœa subside. Tonics—iron, arsenic, quinine, strychnia—may be aided by astringents—mineral acids, opium, bismuth, chalk, or hæmatoxylum. The best preparations of iron are iron alum—3 to 5 grains, and liquor ferri pernitratis—10 to 40 minims. Ipecacuanha and taraxacum are useful when the skin and liver are inactive: from 1 to 3 grains of pulvis ipecacuanhæ may be given night and morning. Podophyllum—2 or 3 minims of a solution of 1 grain in 1 drachm of rectified spirit three or four times a day—is indicated when the motions are watery, pale or high-coloured, and passed with severe cutting pains. Saline purgatives in the early morning are recommended—2 drachms of sulphate of soda, sulphate of magnesia, or soda tartarata on the first day, then 1 drachm for fourteen days, dissolved in a small bulk of water, with avoidance of fluids after the dose—and from 1 to 2 grains of rhubarb, also taken fasting. The profuse sweating and colliquative diarrhœa of hectic is best met by hæmatoxylum and dilute sulphuric acid, or opium with astringent mineral salts—nitrate of silver, sulphate of copper, or acetate of lead—by the mouth or rectum.

Suppressed secretions, particular cachexiæ, disturbed innervation, congestion of the portal vein, and organic diseases of the intestines, form special indications for treatment when diarrhœa is present. GEORGE OLIVER.

DIATHESIS (*διατίθημι*, I dispose).—A morbid constitution, predisposing to the development of a particular disease. *See* CONSTITUTION, with which, in a somewhat more limited sense, this term is synonymous.

DIATHETIC DISEASES—Constitutional diseases. *See* CONSTITUTIONAL DISEASES.

DICROTISM (*δίς*, double, and *κρότος*, a stroke) is a term applied to the second great wave of the pulse. This dicrotic wave or dicrotism is due to a second expansion of the artery which occurs during the diastole of the ventricle. The *pulsus bis feriens* of old authors was a pulse in which a second beat became perceptible to the finger; an occurrence observed occasionally as an antecedent of hæmorrhage and also in the course of fevers. The second beat perceived by the finger is not always the true dicrotic wave, but may in some cases be an exaggerated tidal wave. This is the wave perceived in the high arterial tension sometimes antecedent to hæmorrhage. The mode of production of dicrotism is not quite agreed on; it is favoured by a low state of arterial tension, by elasticity of the arterial coats, and by quick and strong ventricular contractions. It is generally considered to be central in its origin, and to be a wave of recoil from the closed aortic valves reinforced by an oscillation set up in the aorta. The other view refers the origin of the dicrotic wave to the periphery. The wave of blood discharged at each ventricular systole is, in consequence of its acquired velocity, disturbed from its state of equilibrium, and, as a result of the resistance offered by the peripheral vessels, reflows towards the heart, whence it is again reflected. *See* PULSE.

BALTHAZAR FOSTER.

DIET.—DEFINITION.—Diet may be defined as expressing the regulation of food to the requirements of health and the treatment of disease.

GENERAL PRINCIPLES.—In order to sustain life, a diet must consist of a proper apportionment of the following alimentary principles:—

1. Nitrogenous principles.
2. Non-nitrogenous principles (fats, carbohydrates, &c.)
3. Inorganic materials (saline matters and water).

Whilst these principles hold different relative positions of value, the absence or deficiency of either group will render a diet unfit for the support of life. Milk, the product provided by Nature as the sole article of sustenance during the early period of the life of mammals, may be regarded as furnishing us with a typical dietetic representative of all these principles. The egg also holds a like position, and, as all the parts of the young animal are evolved from it, must needs comprise all the materials for the development and growth of the body.

The required principles are contained in food derived from both the animal and vegetable kingdoms, and the diet may be drawn from either; but, looking to man's general inclination and the conformation of his digestive apparatus, it may be assumed that a mixed diet is that which is designed in the plan of Nature for his subsistence, and it is that upon which he attains the highest state of physical development and intellectual vigour.

Animal food, being identical in composition with the body to be nourished by it, is in a state to be more easily appropriated than vegetable food. It also appeases hunger more thoroughly and satisfies longer: in other words it gives, as general experience will confirm, greater stay to the stomach. Animal food possesses stimulant properties which have sufficed in certain instances, as after starvation, and in those accustomed to a vegetable diet, to produce a state allied to intoxication. This stimulating effect is further illustrated by looking at the relative character of animal and vegetable feeders. Liebig says that it is essentially their food which makes carnivorous animals in general bolder and more combative than the herbivora which are their prey. He then relates that a bear kept at the Anatomical Museum of Giessen showed a quiet gentle nature as long as it was fed upon bread, but a few days' feeding on meat made it vicious and dangerous.

The standard diet framed by Moleschott has been accepted as furnishing a model of what may be considered the requisite proportion of alimentary principles for maintaining health in a person of average stature under exposure to a temperate climate and a moderate amount of muscular work. It runs as follows:—

Alimentary substances in a dry state required daily.

Dry Food	In ounces avoir.
Albuminous matter . .	4·587
Fatty matter . . .	2·964
Carbo-hydrates . . .	14·250
Salts	1·058
	22·859

This, it will be seen, furnishes a supply of about 23 ounces of dry solid matter, and of this one-fifth is nitrogenous. If we reckon that ordinary food contains about 50 per cent. of water, then 23 ounces will correspond to 46 ounces of solid food in the condition in which it is consumed. To complete the alimentary ingesta, a further quantity of from 50 ounces to 80 ounces of water may be assumed to be required to be taken daily under some form or other.

For a life of inactivity, it must be stated that a much smaller amount of food will suffice. The diet, for instance, which is ordinarily supplied to the patients of Guy's Hospital, and which suffices to satisfy and properly sustain them, only contains about 30 ounces of solid food, equivalent to about 17 ounces of water-free material.

It has been mentioned that there are reasons for regarding a mixed diet of animal and vegetable food as best adapted to our nature, and it may probably be considered that the most suitable admixture contains about one-fourth or rather more of animal food.

Looked at from the following point of view, it will be seen that an admixture of animal and vegetable food more economically supplies what is wanted, than either kind taken alone, unless the adjustment should be made with the proper apportionment of fat as a representative of a non-nitrogenous article. It is estimated that for a man of medium stature, and performing a moderate amount of work, about 300 grains of nitrogen and 4,800 grains of carbon are daily required to be introduced into the system with the food, to compensate for the outgoing of these elements that occurs. Now this is yielded, as nearly as possible, in the case of both elements, by 2 lbs. of bread and $\frac{3}{4}$ lb. of meat—that is, 44 ozs. of solid food, of which about one-fourth consists of animal matter. If the lean of meat only were consumed, rather over 6 lbs. would be needed to furnish the requisite amount of carbon, and there would be a very large surplus of unutilisable nitrogen; whilst if bread only were taken, the amount necessary to supply the requisite quantity of nitrogen would be rather more than 4 lbs., and this contains nearly double the amount of carbon wanted.

In order to preserve health it is necessary that a portion of the food consumed should be in the fresh state, and this applies to both animal and vegetable food. There may be no lack of quantity, and yet disease and death may be induced by inattention to this fact. Affections of the scorbutic class are produced, which can only be checked and removed by the supply of fresh food or the juice of some kind of succulent vegetable or fruit. The efficacy of lemon and lime juice, for instance, is well known in the prevention and cure of scurvy.

Climate influences the demand for food, and instinct leads to the adaptation of diet to the requirements that exist. Not only is there a correspondence between the amount of food required and the inclination for taking it, but the nature of the food selected in different countries varies and stands in harmony with that which is most in conformity with what is needed. The dwellers in the arctic regions, besides consuming a large quantity of food, partake of that kind which abounds in the most efficient form of heat-generating material, namely, oleaginous matter. In the tropics, on the other hand, it is upon vegetable products, largely charged with principles belonging to the carbo-hydrate group, that the native inhabitants mainly subsist.

Labour necessitates a supply of food in proportion to the amount of work done. The employer finds that the appetite of a workman may be taken as a measure of capacity for work—in other words, that a falling off of the appetite means a diminished capacity for the performance of labour.

Until recently, it was considered, in accordance with the teaching of Liebig, that muscular and nervous action resulted from an oxidation of muscular and nervous tissue, and that according to the amount of action occurring, so was a demand for the supply of nitrogenous alimentary principles created to replace the oxidised material. It is now held, however, that the non-nitrogenous elements of food contribute, as well as the nitrogenous, to the production of muscular and nervous force. Fick and Wislicenus undertook a known amount of work upon a non-nitrogenous diet, and proved that the oxidation of their muscular tissue, as measured by the amount of nitrogen voided with the urine, sufficed only for the production of a small proportion of the force expended in the accomplishment of the work performed. The muscles, in reality, appear to stand in the position of instruments for effecting the conversion of the chemical energy evolved by the oxidation of combustible matter into working power. Fats and carbo-hydrates can furnish the combustible matter required, and, under ordinary circumstances, probably do largely, if not chiefly, supply it. Nitrogenous matter can do so likewise, but it has to undergo a preparatory metamorphosis for effecting the separation of nitrogen in a suitable form for elimination. It must be said, however, that experience shows that hard work is best performed under a liberal supply of nitrogen-containing food. The explanation of this probably is that it leads to a better-nourished condition of the muscles and of the body generally. Under the use, for instance, of animal food, which is characterised by its richness in nitrogenous matter, the muscles are observed to be firmer and richer in solid constituents than under subsistence upon vegetable food.

Persons who lead a sedentary and in-door life naturally require less food than those engaged in active work, and less should be consumed by them to prevent the system becoming clogged with effete products, which act perniciously in various ways upon the body. The food should also be largely constituted of non-nitrogenous principles, as these tax the excretory organs less than the nitrogenous.

The diet of *infants* is a branch of dietetics the importance of which can scarcely be overrated. The proper food during the first period of infancy is that which has been provided by Nature for the young of mammals, namely, milk. Up to about the eighth month the infant is designed to be sustained solely by its parent's milk. The teeth, which ordinarily begin to show themselves about this time, indicate that some solid matter should now be consumed, and one of the farinaceous products will be the most suitable with which to commence. Bread, baked flour, plain biscuit, or one of the numerous kinds of nursery biscuits that are made, may be employed for a time as a supplement to the former food. At about the tenth month the mother, who ought previously to have commenced lessening her own supply, should now cease it altogether. As the child advances through its second year and the teeth become more developed, meat, preceded for awhile by gravy, may be given. If the mother cannot suckle her child, or a wet nurse, whose supply stands next best to that of the mother, be provided, the milk of one of the lower animals should be obtained, and that of the cow gives the nearest approach to what is wanted. Cow's milk, however, is richer in all its solid constituent principles than woman's, and the addition of a solution of sugar or—what is more in conformity with the natural supply—sugar of milk (lactine), in the proportion of an ounce to three quarters of a pint, is needed to bring the two in closer approximation. The milk of the goat is even richer in solid constituents than that of the cow, and therefore stands somewhat further removed from that of the human subject. If, however, it is not adapted for infants, it is highly useful for improving the condition of badly-nourished children, and is sometimes employed for this purpose.

Therapeutical Applications.—The application of the principles of dietetics may be successfully brought to bear in the treatment of corpulency and thinness. A diet rich in nitrogenous matter conjoined with exercise promotes the growth of muscle, but the fat undergoes no increase. The conditions most conducive to an increased accumulation of fat are a diet rich in either fat or carbo-hydrates (provided the requisite amount of nitrogenous matter be present for affording what is wanted for the nutritive operations of life), exposure to a warm atmosphere, and inactive habits. A supply of fat in a direct manner, leads to an increased deposition of fat in the system, but the carbo-hydrates require in the first place to undergo assimilative change before they can be applied in the same direction.

The details of the dietary to be prescribed where the aim is to produce increased stoutness and an improved condition of the body, should comprise such articles as fat meats, butter, cream, milk, cocoa, chocolate, bread, potatoes, farinaceous and flour puddings, oatmeal porridge, sugar and sweets, sweet wines, porter, stout, and ales.

The converse mode of dieting is necessary for reducing stoutness. Mr. Banting, by his noted system of dieting, reduced his weight from 14 stone 6 lbs. to 11 stone 2 lbs. in about a year. Besides altering, however, the character of his food, he limited the quantity in a manner that must have contributed an important share towards producing the effect observed; not more than twenty-two to twenty-six ounces of solid food (corresponding with eleven to thirteen ounces of water-free material) being consumed, according to his statement, in the twenty-four hours.

As a guide to the corpulent it may be said that the fat of meat, butter, cream, sugar and sweets, pastry, puddings, farinaceous articles as rice, sago, tapioca, &c., potatoes, carrots, parsnips, beetroot, sweet ales, porter, stout, port wine, and all sweet wines should be avoided, or only very sparingly consumed. Wheaten bread should only be partaken of moderately, and brown bread is to some extent better than white. The gluten biscuits which are prepared for the diabetic may, on account of their comparative freedom from starch, be advantageously used as a substitute for bread in the treatment of obesity. The articles that may be taken to the extent of satisfying a natural appetite, are lean meat, poultry, game, eggs, green vegetables, succulent fruits, light wines, dry sherry, and spirits. Milk should only be taken sparingly.

Holding the position that food does in relation to the operations of life, the art of dietetics not only bears on the maintenance of health but is capable of being turned to advantageous account as a therapeutic agency; and it is not too much to say that success in the treatment of disease is oftentimes dependent upon a display of judicious management in regard to food.

In the therapeutic application of dietetics the maxim should be held in view that, whilst the particular requirements are secured, there should otherwise be no greater deviation from what is natural than the special circumstances of the case demand.

The quantity of food consumed may require to be regulated as well as its nature. The quantity administered at a time should stand in relation to the power of digesting it; and to properly compensate for a diminished capacity for taking quantity there should be a corresponding increase in the frequency of administration. 'Little and often' is the maxim to be followed upon many occasions, and much will sometimes depend upon the strictness with which it is acted up to; for, apart from harmonizing with what is wanted, upon the principle that has just been referred to, it meets the defective aptitude that exists in sickness for sustaining any lengthened duration of abstinence from food.

In febrile, acute inflammatory, and other conditions where there is a failure of digestive power, the food administered should be such as not to tax the stomach, and should therefore consist of liquid materials. Solid matter, by remaining undigested—and solids of an animal nature are particularly likely to do so—would act as a source of irritation in the stomach, and only serve to aggravate the condition of the patient. The articles under such circumstances to be selected from are beef-tea, mutton, veal, or chicken broth, whey, calf's-foot and other kinds of jelly, arrowroot and such-like farinaceous articles, barley water, rice mucilage, gum-water, fruit jelly, and the juice of fruits, as of lemons,

oranges, &c., made into drinks. Where a little latitude is allowable, the employment of milk and of eggs in a fluid form may be sanctioned. As circumstances permit, an advance may be made to solid substances which do not throw much work on the stomach, as rice, sago, tapioca, bread and custard puddings, and stale bread or toast sopped. Next may be allowed fish, beginning with whiting. As power becomes restored, calves' feet, chicken, game, and butcher's meat—mutton to begin with—may be permitted to follow.

In cases of ordinary dyspepsia the aim of the physician should be rather directed to raising, by appropriate treatment, the digestive capacity to the level of digesting light but ordinary food, than to reducing the food to an adjustment with a low standard of digestive power. Of butcher's meat, mutton is almost invariably found to be the most suitable; chicken and game are allowable, also white fish (boiled or broiled) particularly whiting, sole, flounder, and plaice. Stale bread, dry toast, plain biscuits, floury potatoes, rice, and the various farinaceous articles form the kind of food derived from the vegetable kingdom to be selected. Green and other succulent vegetables, it is found, are more apt to create flatulence than other kinds of food, and articles belonging to the cabbage tribe are particularly to be regarded as obnoxious to those who have a tendency to this form of derangement.

Much depends in cases of weak digestion upon the state in which the food reaches the stomach. Thorough mastication affords great assistance to the performance of digestion, and when the teeth are bad the food should be finely minced, or otherwise minutely divided before being eaten. Regularity in the periods of taking food, tends to promote the orderly working of the digestive organs. An interval of more than four or five hours' duration between the meals is to be avoided, as it acts perniciously in several ways. By inducing an exhausted state of the system it diminishes the energy of the digestive organs, and whilst having this effect it at the same time calls for the periodical exercise of increased energy, on account of the larger amount of food which must be taken at each meal to compensate for the length of time that is allowed to elapse between them.

In cases of ulcer of the stomach, acute gastric catarrh, and vomiting, the food must be selected from that which is nutritious and at the same time taxes least the digestive powers. Milk—and this is often better borne after being boiled—milk and water, or milk and soda water, will frequently be found to be tolerated when other articles excite irritation and are returned. Sometimes the milk may be advantageously mixed with isinglass, arrowroot, ground rice, or biscuit powder.

In dysentery and other forms of ulcerative disease of the intestine, scrupulous attention must be paid to diet. The food should consist of articles which are known to exert the least stimulant and irritant action on the mucous membrane and muscular coat of the alimentary canal, and those which best meet the demand in question are such as milk, isinglass, and the various farinaceous products, amongst which rice is pre-eminently valuable. Next to these come eggs, white fish, white-fleshed poultry, fresh game, and fresh meat. Salted and dried meats are highly objectionable, and fruits and succulent vegetables, with the exception of a floury potato, should be strictly shunned. *See* PEPTONISED FOOD.

The development of gout is known to be favoured by the consumption of a highly nitrogenised diet, especially if conjoined with sedentary habits. With those who have already experienced symptoms of the disease, and those also who have grounds for apprehending its invasion, it is important that an excess of nitrogenous food should be avoided. The diet should be simple, in order that the temptation may be avoided of eating too much, and should at the same time be adjusted to the mode of life. The principle to observe is that the higher the degree of inactivity the greater ought to be the preponderance of food derived from the vegetable kingdom.

Even of more importance than what is eaten is what is drunk, where the question of gout is concerned, and observation shows that it is not distilled spirits, but the stronger wines and malt liquors, which favour the production of the disorder. Nothing is more potent than port wine in leading to the production of gout, and a few years' liberal indulgence in it has often been known to be instrumental in bringing on the disease where no family predisposition had existed. Dry sherry and the light wines, as claret, hock, &c., may be drunk, certainly in moderation, with comparatively little or no fear of inducing the disease, although any kind of wine appears capable of sometimes acting as the exciting cause of a paroxysm where the gouty disposition is already established. Stout, porter, and the stronger ales, especially those that have become hard from age, rank next to port wine in their power of predisposing to gout. As regards the light bitter beers, which are so extensively used at the present time, the same must be said of them as of the light wines, viz. that with little, if any, disposition to induce the disease, they nevertheless appear capable of sometimes exciting its manifestation in a gouty subject. A pure spirit, as whisky, hollands, or brandy, diluted with water, often forms the only kind of alcoholic drink that is found to agree with those who are suffering from gout.

In Bright's disease with threatening uræmic poisoning it is a point of consideration to diminish as far as practicable the amount of excretory matter to be eliminated by the kidney. The fats and carbo-hydrates throw no work upon the kidneys. Their products of destruction escape through another channel. Nitrogenous matters, on the other hand, undergo metamorphosis in the system, and yield nitrogen-containing compounds—chiefly urea—to escape by the kidneys. In this way the kidneys become taxed by nitrogenous food, and, to lessen the work demanded of them, reason suggests that the diet should preponderate in food derived from the vegetable kingdom.

In diabetes mellitus there is a want of assimilative power over the saccharine and starchy principles of food. Whilst these principles become utilized and lost sight of when ingested by a healthy person, in the system of the diabetic they fail to become consumed, but pass off under

the form of sugar in the urine, giving rise to severity of symptoms in proportion to the amount of sugar escaping. Much may be done towards subduing the symptoms of the disease by a properly arranged dietetic scheme, and the principle upon which it requires to be framed is the exclusion, as far as practicable, both from what is eaten and what is drunk, of articles containing saccharine or starchy matters.

Observation has shown that the reaction of the urine is susceptible of being influenced by the character of the food. The effect of animal food is to increase the acidity of the secretion, whilst that of vegetable food is to diminish it, and, even it may be, to produce alkalinity. Hence on persons affected with the lithic acid diathesis benefit is conferred by a plan of diet in which animal food is limited, and succulent vegetables and fruits, with the light wines, as claret, hock, &c., are freely supplied. On the other hand, with the phosphatic diathesis, the converse principle of action should be adopted.

F. W. Pavy.

DIGESTION, Disorders of.—The function of digestion is of a physico-chemical nature, being compounded of certain muscular acts, and of certain processes exercised by the digestive fluids on the ingesta.

Any interference with the due performance of the several components of the function will lead to indigestion, and though it may for convenience be desirable to consider these disturbances separately, it must be remembered that the occurrence of one condition is apt to be quickly associated with another, and hence the forms of dyspepsia as they usually present themselves are of a complex nature, however simple the primary fault may have been. Nor is it possible to consider irregularities of digestion only from the point of view of the organs immediately concerned. Complicated as our organism is, disturbances of other functions will speedily make themselves felt in the one under consideration, and failures in the absorption of the digested food, or in its subsequent metabolic changes and elimination, will tell back sooner or later on that process which is, strictly speaking, limited to its preparation. Dyspepsia then may be traced to (i.) the food; (ii.) disturbances of the so-called mechanical processes, viz. the muscular acts, solution, &c.; or (iii.) imperfections in the chemical changes exercised by the digestive secretions.

I. Imperfections of Food.—Imperfections in food, whether in quality or quantity, are among the most frequent causes of digestive disorders. A thorough knowledge of the principles of dietetics is essential, that the errors may be recognised and remedied. Since our digestive capability is limited, it is obvious that when those limits are overstepped, the domain of disease is entered upon; and although no very absolute lines may be laid down for universal application, the general rules for quantity and kind are capable of being stated. *See* Diet.

Even when the food is as it should be, dyspepsia may be determined by perversions of the appetite; or, on the contrary, such perversions may be due to the same causes which lead to the functional errors in the digestive organs. *See* Appetite.

(α) *Deficiency of Food.*—Except under rare conditions, such as famine, &c., this is not so common a cause of disease as is supposed. We habitually take a larger bulk of food than is demanded, and it is very certain that most active lives are led on an amount of food far below what is ordinarily regarded as being necessary. May it not be that many of the diseases looked upon as non-preventible, more particularly those connected with the excretory organs, are really due to their overwork in getting rid of the excess of the ingesta? Of the signs and symptoms of starvation it is not needed here to treat. But there are frequent occasions when, with no deficiency in the total bulk of food taken, there is yet a serious want in one or perhaps more of the needful alimentary principles, and this is especially liable to occur in the feeding of children. Setting aside those gross cases of cruelty, when infants and the youngest children are fed almost from their birth with bread, broth, or even meat, there are still too often to be met with children whose diet-scale is almost entirely wanting in nitrogenous matter. Fed upon milk and infants' foods, the latter consisting of little more than starchy material, their tissues are ill-formed for the want of proteids, which, during the period of growth, are required in a larger relative proportion. The relationship of rickets to prolonged suckling, with the accompanying deficiency in nitrogenous and amyloid food-stuffs, is now generally recognised.

The effect of a deficiency of food is a general state of malnutrition, in which any hereditary tendencies to disease that may exist have a more favourable field for development. There is a gradual diminution in the weight of the body, and an imperfect performance of its functions, as indicated by muscular weakness, mental lassitude, &c.

The deficiency in food taken may result not so much from a defective supply of nutriment, as from a disinclination to eat, a common symptom in most diseases, especially in febrile states, self-imposed fasting too frequent or prolonged, the anorexia of the hysterical temperament, and obstruction to the entrance of food into the stomach from stricture of the œsophagus, or the appetite may be impaired by over-indulgence in alcohol or tobacco.

(β) *Excess of Food.*—There is very little doubt but that more food is daily in the habit of being taken than is actually required to restore the tissue-waste, as there is equally little doubt that much of what is taken is not in the most digestible form. It is open to question whether the appetite would be satisfied by the ingestion of merely sufficient to balance the waste, particularly if the gross bulk of the food taken were diminished by the removal, as far as possible, of all indigestible matters, leaving little more than the needful alimentary principles. At the same time it must not be forgotten that the appetite is very easily controlled by custom, and determination can in time overcome a vicious habit.

An habitual excess of food, at least in this

country, usually errs in the disproportionate amount of nitrogenous matter it contains. Remembering the relatively small quantity of this principle that is essential, and in what a number of the ordinary articles of diet it is contained, this statement will be the more readily accepted. Now, since all the proteid principles require, to fit them for absorption into the blood, a considerable amount of chemical alteration, and, physiologically speaking, there is good reason to believe that the subsequent metabolic changes of these matters, when absorbed, are more complex than those undergone by fats and amyloids, it would follow that those organs concerned in effecting these changes are very prone to suffer from overwork and its sequelæ. Again, it appears very probable that when the amount of nitrogenous food taken is much in excess of what is required, it undergoes certain oxidation-changes in the blood without becoming tissue previously, and an enormous ingestion of albuminoid matter is followed by its elimination very much as it is taken. Now, many of the compounds resulting from the oxidation of nitrogenous matter are liable to become positive poisons in the economy when existing in excess, and the proper elimination of such materials is specially provided for by such organs as the kidneys and skin. The frequency with which these organs become the seat of disease may at least indicate the probability of errors of diet being an important factor in determining the morbid changes, especially as considerable relief is often the result of a restriction of nitrogenous food. There can be little doubt but that the large group of diseases associated with failure in elimination of nitrogenous waste has for a prominent cause an habitual excess of nitrogenous food.

The results of an excessive ingestion of food are as numerous as they are diverse. In many cases there does not seem to be either impairment of health or shortening of life. In some obesity and in others leanness ensues. In a large majority of individuals whose food is much in excess of their wants, particularly if the exercise taken be but little, there are variable symptoms of indigestion, such as a general feeling of lassitude and want of energy, both muscular and mental, a liability to headaches chiefly frontal, constipation, or more rarely diarrhœa, high-coloured urine depositing abundance of urates, a general disposition to sleep, various skin-eruptions, particularly acne, and not infrequently a feeble heart's action from commencing fatty degeneration of its substance. Any or all of these symptoms may exist, and may be more or less completely relieved by a restricted diet. It is impossible to lay down any exact rules for the quantity of food that should be daily consumed; though it is desirable to remember that the tendency is to take too much, at the same time that age, season of year, and occupation are all circumstances determining variations both in quantity and kind.

(γ). *Improper Food.*—Setting aside those extreme cases of perverted appetite occasionally seen in the hysterical condition, there yet remains a very constant violation of the dietetic proprieties. These errors may be classed under the following heads:—1. Substances which are indigestible; either essentially so, or from imperfect preparation (cooking, &c.) 2. Substances which, though digestible, are innutritious or even poisonous. In the first group are included such bodies as the pips and seeds as well as the skins and rinds of fruits, the husks of corn and bran, the stalks and fibres of leaves, and gristle, elastic tissue, and hairs in animal food. For the reducing of these to a fluid and diffusible condition no chemical arrangement exists in the human organism, and they are thrown off very much in the same state as they are swallowed. Many articles of diet depend in great part for their digestibility on their proper preparation by division, cooking, &c. Thus most vegetables when taken in the raw state are but imperfectly digested, and such nutritious food as potatoes becomes when uncooked positively harmful. The apparent value of raw green vegetables, as lettuce, endive, cress, &c., would seem to depend on the peculiar condition of their mineral constituents, rather than on the vegetable tissues.

Such substances as the above-mentioned are apt to produce perversions of digestion in virtue of the mechanical irritation they give rise to, indicated by more or less pain of a griping character (colic), and frequently accompanied by diarrhœa. The constant ingestion of the more formidable may even set up a gastro-enteritis, acute or chronic. Occasionally articles of food, such as brown bread, oatmeal porridge, &c., are taken for the very aperient action they induce, owing to the irritating nature of the indigestible husks they contain. Symptoms of acute dyspepsia very frequently follow the taking of meat foods enveloped in greasy sauces, since the fat, being undigested in the stomach, prevents the action of the gastric juice on the proteid matter, which then passes on into the intestines, setting up irritation like any other indigestible substance. The most interesting among those articles of diet which, though easily digested may be poisonous, are those producing their effects only on certain individuals. Such, for example, are certain mushrooms, shell-fish, or indeed any fish. Remarkable cases are authentically recorded of serious and even fatal results following their ingestion. The symptoms may be those of an acute gastro-enteritis, or, as is very frequently the case, an urticaria is the result, with or without swelling of the eyes and throat. Severe nervous prostration has been met with occasionally. Be it understood that other people have partaken of the same diet with no ill results. The writer is acquainted with a gentleman who for many years was unable to remain in the room when fish of any kind was on the table; its presence inducing severe vomiting, abdominal pain, and general illness; and although the effects are now but slight from the mere smell of such food, very marked symptoms follow on partaking of any. The most digestible and nutritious articles of food may determine indigestion when taken too hot or too cold.

Finally must be included those substances which accidentally find their way into the alimentary canal with the food, as entozoa, ergot of rye; such foreign bodies as pins, needles,

coins, buttons, &c.; or lead and other metallic poisons off the hands of workers in these poisons; all of which give rise to definite and for the most part characteristic symptoms.

II. Irregularities of the Mechanism of Digestion.—The motor factors of the digestive process depend for their due and normal performance on the integrity of the muscular tissue, the nerve-centres, and the connecting nerves. The several stages of the entire process are mastication, deglutition, the churning movements of the stomach, the peristaltic action of the intestines, and defæcation. Each of these is liable to impairment, in the direction of excess (spasm), or of deficiency (paralysis), due either to lesions of the nerve-centres whence the motor stimuli emanate, of the nerve-fibres by which these stimuli are conveyed, or of the muscular tissue by which the movements are performed. Not unfrequently more than one of these tissues may be at fault. Lastly, obstructions to the movements may be caused by tumours, cicatrices, &c. Irregularities of mastication, deglutition, and defæcation are fully considered elsewhere.

1. *Paralysis.*—Arrest of the peristaltic action of the gullet, stomach, or intestines, is undoubtedly often associated with diseased conditions of the central nervous organs, but the exact connection is far from being satisfactorily known. Those lesions which interfere with the action of the vagus nerve, and remove its accelerating influence over the peristaltic movements, have been regarded as most likely to bring about this condition. The nervous exhaustion induced by long fasting, continued vomiting, hysteria, and such diseases as typhus and puerperal fever, have been noticed as removing the influence of the pneumogastric. Over-brainwork, with the attendant altered conditions of cerebral vascularity, have been found to be accompanied with symptoms indicating loss of power of the muscular coat of the bowel; possibly in this case also the influence is conveyed by the vagus.

Paralysis of the stomach and intestines is a frequent result of affection of these organs themselves. Inflammation of the peritoneal or mucous coats, with the subsequent infiltration of the muscular coat with the inflammatory products, materially diminishes the power of the contractile tissue. Degeneration of the organs, particularly the lardaceous variety, which commencing in the mucous subsequently invades the muscular coat, obviously interferes with the movements. The movements of the alimentary canal may be considerably diminished by the administration of certain drugs, such as opium.

The results of these various paralytic affections are in most cases sufficiently apparent. The palsied lips and cheeks and tongue tell their own tale by the half-opened mouth, the dribbling saliva, and the cheeks distended with food which cannot be kept between the teeth. When the fauces and pharynx are affected, the painful efforts at swallowing, the rejection of food through the nose, and the passage of food into the larynx are signs not to be mistaken. Paralysis of the stomach and intestines is mainly recognised by the constipation from inability of the canal to propel its contents, and by the distension with gases, &c., which ensues; whilst the involuntary passing of the fæces indicates paralysis of the sphincter ani.

2. *Spasm.*—Spasmodic affections of the alimentary canal are characterised by an increased motor activity dependent on many causes for its production. However diverse such causes may be, they ultimately resolve themselves either into an increased irritability of the nervous and contractile tissues, or into some unusual or excessive stimulation, arising *ab extrâ*, and so producing its motor result in a reflex manner, or originating automatically in the cells of the motor ganglia. Spasms affecting the organs under consideration are determined both by central and peripheral causes, and occasionally by affections of the nerves independently of the nerve-centres. They are mainly of the tonic variety, and are usually accompanied by pain.

It is clear that with the muscular tissue of the alimentary canal arranged as it is, when a condition of spasm exists obstruction to the passage of the contents of the canal will take place, in proportion to the extent and duration of the cramp.

Spasm of the stomach and intestines is almost invariably accompanied by pain; and it is for that symptom, rather than for any obstruction, that the condition comes under notice. The pain at the back, so frequently complained of in anæmia, is believed to be mainly due to gastric spasm; and in certain other constitutional states, such as gout, it may be a prominent symptom. Occasionally it is due to uterine or ovarian disturbances, acting in a reflex manner. Spasm of the pylorus is of theoretic rather than practical interest. Intestinal cramp (colic, tormina, &c.) is of frequent occurrence as the result of irritating ingesta, lead-poisoning, hernia, intussusception, and ulceration in malignant disease. These spasmodic affections may also result from diseases of the spinal cord. How far over-action of the involuntary muscular tissue of the alimentary tract may exist without pain is uncertain; since we are ordinarily unconscious of the peristalsis, it is probable that any exaggeration of action is painful.

The normal tenacity of the sphincter ani may give place to painful spasm, a condition which is very apt to complicate fissure and ulcer of the anus.

Hyperkinesis, or exalted motor activity of the muscular tissue of the digestive organs, may be a part of the general state induced by such poisons as strychnine.

3. The due performance of the mechanism of digestion may be interfered with by alterations in the condition of the alimentary canal caused by various kinds of obstruction or dilatation. Thus deglutition may be rendered difficult or even impossible by a swollen tongue or tonsils, post-pharyngeal abscess, tumours of the œsophagus or larynx, or new growths situated at the cardiac aperture of the stomach. The various obstructive diseases of the pylorus and intestines will obviously interfere with the proper passage of the contents, and in those dilatations of the canal, which are liable to develop above a stricture, the food accumulates and is delayed in its passage. The adhesion of coils of the bowels to each other or to adjacent structures is a further source of imperfect movement.

Lastly, the subdivision of the solid food, so necessary for the effective action of the digestive juices, is only imperfectly performed when the teeth are deficient in number or are carious, and to this cause a large proportion of cases of dyspepsia may be fairly assigned.

So marked a perversion of the mechanism of digestion as vomiting is more fitly described by itself, though it is a very frequent symptom of indigestion.

III. Imperfections in the Chemical Changes.—Our knowledge of the normal chemistry of digestion, much as it has advanced of late, is still very far from complete, and, in face of our ignorance, but little can be said of the conditions existing in disease. Yet there are certainly no departures from the healthy working of the body so common as are those associated with the digestion of the food.

The various secretions, whose office it is to convert into a fluid and diffusible form those alimentary principles which without such preparation cannot be absorbed, are formed from the blood by the salivary, gastric, pancreatic, hepatic, and intestinal glands. It is clear that, for these juices to be secreted in proper quantity or of proper composition, the blood no less than the secreting cells must be in a healthy condition. If the circulating fluid be laden with imperfectly secreted products of tissue-change, or if it be charged with poison, of whatever origin, it is not to be expected that a normal secretion is to be obtained from it; whilst on the other hand a degenerated secreting epithelium is unable to perform a function intimately dependent on the integrity of its protoplasm. Of necessity these two factors—blood and cells—react on one another; any flaw in the one is reciprocated by the other, and thus becomes intensified by mutual interdependence. Experiment leads us to ascribe the efficacy of these juices in the changes they effect to the existence in them of certain so-called ferments, whilst the result they bring about is mainly one of hydration. How far the various mineral constituents of the secretions aid in the process is uncertain, but at least their presence cannot be dispensed with. In this way, the insoluble starches of our food are converted by the saliva, the pancreatic, and possibly the intestinal juices, into soluble and diffusible sugars; the various proteids are rendered capable of absorption into the blood, by the gastric and pancreatic juices, and perhaps also the succus entericus, being changed into bodies known as peptones. The fats are prepared for absorption by the bile and pancreatic juice, by being in part reduced to a sufficiently minute state of subdivision (emulsion) to permit of their passage through the tissue-interstices, and partly by being chemically altered into soaps. However closely we may imitate the separate actions of these fluids in our test-tubes and laboratories, the conditions are undoubtedly much more complicated in the alimentary canal, where so many sets of changes are going on, and so many sets of products are formed.

Despite our imperfect knowledge we can yet suggest in outline the causes of the abnormal chemical changes, however far we may be from ascribing with accuracy to their proper conditions the multiform symptoms which such changes undoubtedly give rise to.

Primarily the secretions may be deficient in quantity, improper in quality, or both, and the following are some of the causes leading to such results:—

1. *Perverted nervous influence.* The direct control of the nervous system over the quantity and quality of the secretions is well known, and there is every reason to suppose that the temporary arrest of the salivary fluid so frequently accompanying any severe mental disturbance, such as fright, represents, but in a transitory manner, a disturbance that may be more lasting and more serious in lesions of the central nervous organs. The imperfect digestion, as indicated by the tongue, breath, excreta, &c., so common in brain-diseases, even when all precautions are taken, is only to be explained in this way. There is nothing improbable in suggesting that a cause which may in one case bring about an arrest of secretion, may, if prolonged, induce a perversion of the same.

2. *Abnormal blood-supply.* A deficiency in blood being almost always associated with an alteration in its quality, it is easy to see why in a state of anæmia the digestive function suffers, whilst the more it fails the more will the anæmia increase. Hence the care needed both in diet and drugs for such patients. In some cases the blood may be wanting in those constituents which go to form the secretions. Occasionally persons are met with who, from habit or inclination, take a quantity of fluid far below the ordinarily supposed requirements. In such the secretions would seem to be insufficient in quantity to do their work, and an irritable form of dyspepsia, caused by the presence of imperfectly digested food, is the result. Or again, certain symptoms may point to a deficiency in such special elements of the secretions as hydrochloric acid, bicarbonate of potash, &c., and considerable relief or a cure may follow the administration of these substances, or it may be the ferments themselves are wanting, and pepsin or pancreatin are indicated. It is not asserted that our knowledge at present leads us to recognise with accuracy the exact nature of the deficiency in the secretions, but in view of the relief that is afforded by acting on the lines laid down by physiology, it is only reasonable to expect that in time the expressions of disease may be more exactly defined, and so a rational basis constituted for treatment. After prolonged fasting the gastric juice is secreted in but small amount, and under ordinary conditions that which is first poured into the stomach is far less active than that later formed. In other words the quality of the secretion improves as the food, which supplies its ingredients, is absorbed. Hence the occasional advantage of prefacing a meal with a small quantity of some piquant food.

From a blood laden with impurities, whether of ingesta or non-eliminated products of tissue-waste or specific poisons, healthy secretions are not to be expected, even did the secreting agents remain healthy. Thus the dyspeptic symptoms associated with alcoholism, gout, and the acute specific diseases are to be explained.

3. It has already been said that it is practically impossible to disassociate altered blood

states from perverted tissue-structure; and if the nutritive fluid of the body be diseased, the elements nourished by it may be expected to be imperfect. Some of these departures from the normal are not recognised, partly from the difficulty of observing them, and still more from ignorance of the exact standard of healthy structure in tissues which are perpetually changing, even within healthy limits. Other changes, however, we can see; and the degenerate cells of an amyloid liver, or the desquamating epithelia of the gastric follicles in scarlatina, can no more be expected to eliminate healthy secretions, than can a fatty heart to contract properly.

A further source of disturbance in the chemical changes in digestion is to be found in the fermentative and putrefactive processes set up in the contents of the alimentary canal. How far such processes are normal is uncertain; but occasionally the contents of the stomach are vomited in a state of active fermentation, and teeming with living organisms. All ill-smelling gases and excreta may be, indeed, indicative of the progress of putrefaction lower down in the canal. That gastric juice and bile will normally arrest putrefaction, whilst pancreatic juice favours it, is well known, and hence we are led to infer some alteration in the secretions when signs of decomposition appear.

Symptoms of Dyspepsia.—The almost numberless symptoms which indicate the perverted functions above described, may be considered as those associated with the special organ at fault; and those manifested by the system generally.

(*a*) Among the first group are *perverted sensations*. Ordinarily we are unconscious of the process of digestion, but in disease the function may be accompanied by alterations of sensation, varying from a mere sense of weight and discomfort in the abdomen to the severe spasmodic pain of colic. The ingestion of food may be followed by a feeling of abnormal repletion, or of emptiness with craving for food; or there may be heartburn, an ill-defined sense of burning felt in the epigastrium or over the chest, or extending to the throat, or positive pain or tenderness felt over some tolerably definite area. Sensations as of excessive movements of the bowels, of sinking, or of tightness across the abdomen, are of frequent occurrence.

(*b*) Affections of the *appetite* as results of indigestion have already been referred to.

(*c*) The various *movements* of the alimentary canal may be interfered with. They may be delayed or even arrested, as occurs in constipation; or excessive, with consequent diarrhœa. Vomiting, either directly or at a variable interval after taking food, is a common symptom, with or without pain; very frequently the vomiting relieves the unpleasant feelings that may be present. Eructations of gas, hiccough, and the frequent passing of much flatus occur in many cases.

(*d*) The *vomited matters* vary considerably. The food may be ejected very much as it has been swallowed, or it may be in a state of active fermentation and turning into ferments. A symptom very often complained of is the eructation into the mouth of a fluid, which is frequently acrid and bitter, at other times tasteless (pyrosis): it is probably altered astric secretion. Blood may be vomited (hæmatemesis); or passed per rectum (melæna). The breath may be foul.

(*e*) The state of the *tongue*, its colour, size, and general appearance as to fur, dryness smoothness, and prominence of papillæ, are often indicative of the condition of the stomach and intestines.

(*f*) Such *sympathetic* symptoms as headache, pain in the back or in the right shoulder, dizziness, specks in the field of vision, palpitation, or irregular action of the heart, cough, disordered urine, &c., indicate the relation existing between the digestive organs and the body generally.

(*g*) The more *general* symptoms that are found associated with disordered digestion may be those of pyrexia, when an acute inflammatory condition of the digestive organs is the cause of the disturbance. Since, however, the affections are more usually of a chronic nature, a general wasting and emaciation from insufficient nourishment is likely to ensue. In such a state the patient is prone to develop any diathesis to which he may be liable, such as the neurotic, cancerous, &c. The peculiar sallow, muddy-looking skin, often slightly tinged with bile and markedly anæmic, is characteristic of many cases of chronic indigestion; a poorly nourished body can ill stand the slightest fatigue, though such patients are often apt to brighten up towards evening, and indeed as a rule dyspeptic patients are worse in the morning. All conditions of disordered temperament are met with, from a confirmed apathy and hypochondriasis to a persistent and increasing irritability. Whilst some patients are always drowsy, others complain of a distressing insomnia or a troubled and dreamy sleep.

Treatment.—Oftener perhaps than may be supposed, the cause of the disturbance of digestion is a removable one; in any case it must be well searched for, and arrested if possible. A carefully regulated diet, both as regards ordinary food and drinks and special idiosyncrasies, is in all cases the most important, and the means from which much good is to be expected. Exercise, bathing, occupation both mental and bodily, change of scene and air, will require attentive consideration. Much, however, may be done with the aid of drugs. Sufficient indications often exist to justify prescribing, with perfect confidence, such tonics as vegetable bitters, quinine, strychnine, and iron; such constituents of the digestive juices as mineral acids, pepsin, and alkalies; or drugs whose value appears mainly to consist in their sedative action, as hydrocyanic acid, bismuth, opium, and belladonna. Arsenic, zinc, silver, creasote, charcoal, valerian, the hypo-sulphites, and the carminatives generally, are a few among the long list whose value is assured in different cases of dyspepsia. It is important to attend to the condition of the bowels; as well as to the hepatic functions. *See* Stomach, Diseases of.

Conclusion.—In the foregoing remarks no attempt has been made to enter into a detailed description of the various symptoms of disordered digestion, or to do more than indicate very generally the treatment to be followed. Such subjects are left to the diseases treated of in their respective articles. Nor has it been thought desirable in this article to treat the subject from the ill-

defined point of view of 'varieties of dyspepsia.' Rather it has been sought to bring the matter of indigestion within the limits of an anatomico-physiological basis, since it is only on such lines that the protean symptoms of dyspepsia can be accurately defined. At the same time, whilst for clearness the various causes have been made to assume a somewhat tabular form, it is not intended that the interdependence of these states should be overlooked, or that one only of the causes mentioned is at work in any given case. The complexity and harmony of our functions alike forbid such a mistake being made. Yet for that mental analysis which the formation of a diagnosis presupposes, some such scheme as the foregoing is essential, no less than for the adoption of a rational treatment.

W. H. Allchin.

DIGESTIVE ORGANS, Diseases of the.—The organs comprised in the digestive system have for their function the preparation of the solid and fluid ingesta of the body, so as to fit them for absorption into the blood. Some of the food requires little or even no such preparation; some needs considerable treatment, both physical and chemical. To effect this object it would appear to follow that there should be some receptacle or series of receptacles into which the food may readily be taken, and from which the worthless residue may escape, provided with muscular structures to ensure a movement of its contents. It would further follow that there should be certain organs communicating with the foregoing, whose function it should be to prepare those materials necessary to effect the required chemical changes in the food; and, lastly, that some arrangement should exist to permit of the ready absorption of the digestive materials. Such requirements we find supplied in the alimentary canal, with its terminal apertures, and its continuous muscular coat so arranged as to maintain a progressive advance of the contained food, though with varying degrees of speed—for some lengths, as through the gullet, without any arrest; in others, as in the stomach, with considerable delay. Into this canal open numerous glands (mucous, salivary, gastric, intestinal, hepatic, and pancreatic), the secretions of which play each their special part in the conversion of the food to a fluid and diffusible state. From an anatomical, and indeed a genetic point of view, these glands may be regarded as more or less complicated diverticula of the mucous surface. In order that the food when so treated may gain a ready entrance into the blood, the surface of the canal in contact with the digesting food—mucous membrane—offers various modifications—villi, &c.—to facilitate the process of absorption. Lastly, in beings so complex in structure as man, there is need for some controlling influence to bring the operation of this system of organs into harmony with the actions of other and interdependent systems. Such power of co-ordination is exercised *viâ* the nervous system, sympathetic and cerebro-spinal.

By the expression 'diseases of the digestive organs' is meant, departures from the normal structure of the tissues of which these organs are composed.

The constructive tissues of the alimentary organs are:—1. The Epithelial; 2. The Connective; 3. The Muscular; and, 4, a compound texture—the Vascular. Each of these is subject to its own perversions, either alone or in common with others.

Ætiology.—If we consider diseases to be altered functions dependent on altered structure, the latter being determined by some perversion in the normal stimuli to nutrition, either hereditary or acquired, we shall at once recognise that the opportunities for abnormal stimulation in the case of the digestive organs are most numerous. Communicating with the external world and continuously subject to the admission of foreign matter, we have in the character of the ingesta abundant sources of disease. Toxic agents, living and dead, find ready entrance, and excesses in quantity of food, no less than imperfection in its quality, alike serve to produce those departures from the normal structure on which perversions of function depend.

Furthermore, the tissues of the alimentary viscera are, equally with those of the body generally, subject to those more obscure hereditary influences which determine irregularities in structure and their sequence. And, finally, arrests in development of organs, not unfrequent in those under consideration, complete the list of possible diseases to which the alimentary system is liable.

Nor is this system independent of morbid conditions affecting other organs. So complicated as is the human body it is impossible that disease should for long be limited to one region. Sooner or later the functions which are now reacting the one upon the other, to constitute the harmonious working of healthy life, will feel the effects of the one that is out of gear, and will respond each in its own manner to the abnormal condition. A disease primarily located in the nervous system will produce an effect in the working of the nutritive functions, none the less real because the exact lesion cannot as yet be determined. Failures in elimination of the products of tissue-waste from structural diseases of the excretory glands, must tell back on the organs concerned in the preparation and elaboration of the ingesta, and such conditions constitute a frequent cause of disorders of digestion. The causes may be thus tabulated:—

A. Hereditary.

1. Arrests in development of tissues and organs.
2. Abnormal nutritive stimuli, determining new growths, &c.

B. Acquired.

1. Poisons,
2. Imperfections in quantity or quality of normal ingesta.
3. Failure of excretory functions with consequent circulation of an impure blood, and malnutrition of tissues.
4. Trophic disturbances acting *viâ* the nervous system.
5. Traumatic.

Classification of Diseases.—There is scarcely any form of diseased structure that is not to be met with in the tissues comprising the digestive organs. Since almost every variety of texture is

found in them, and there is so extensive a liability to the causes of disease, this result is only to be expected.

I. **Affections of the Vascular State.**—Regarded collectively, the organs of digestion present several points in respect to their blood-supply worthy of remark. First, the arrangement of the vessels is such as to ensure a very extensive, and at the same time, very direct supply. The arteries to those alimentary organs situate in the abdomen are almost all primary branches of the aorta, and this, together with the numerous and free anastomosis between them, reduces to a minimum the chance of failure in circulation. Secondly, the blood from the same area is all collected into one large vein, the portal, and after circulating through the liver is carried by one—the hepatic—directly into the inferior vena cava close to the right auricle. Such an arrangement, whilst perhaps facilitating the direct return of blood, offers a double chance—viz., in the liver and in the heart—of producing a very general state of congestion of the alimentary tissue. Thirdly, the existence of such an organ as the spleen, which by its position and structure allows of great variation in the amount of blood it contains, will considerably affect the extent of vascularity of the digestive organs. Our knowledge of the conditions determining the variations in splenic blood-capacity is most imperfect, beyond the fact of the constant enlargement which the organ undergoes after a meal and its subsequent contraction after a few hours, the enlargement being due in great part to increase in the amount of blood contained in it. And, lastly, the alimentary organs probably undergo, within normal physiological limits, a wider variation in amount of blood than does any other system.

1. *Hyperæmia* is an excess of blood in the arterial side of the capillaries. How far a determination of blood to the alimentary canal may exist, unaccompanied by any change in the tissues, is a matter of doubt. In the normal process of digestion this condition obtains, but with it there is an alteration in the glandular epithelia, if in no other tissue-elements. It is conceivable, however, that a vaso-motor paralysis with consequent fluxion may occur, and such may be the case in certain mental states, as indicated by diarrhœa. The majority of circumstances that produce hyperæmia do not stop at that point, but bring about a state of catarrh and inflammation, in which the epithelial and connective tissues are also engaged. Exposure to cold and extensive superficial burns probably produce their well-known results of intestinal catarrh in this manner.

Among the digestive glands, the liver undoubtedly manifests states of simple hyperæmia without any appreciable changes in the parenchyma of the tissues. Excessive feeding, irritants such as spices and alcohol, hot climates and malaria, have all been recognised as producing temporary enlargements of the liver from vascular engorgement, although without doubt these causes if continued lead to structural affections.

2. *Congestion*, or an excess of blood primarily in the venous side of the capillaries, brought about by some impediment to the return of the blood in the veins, has little or no analogy with any normal physiological action. As a condition of disease it is more important and far more common than the preceding.

The two chief causes leading to its occurrence are—(A) Obstruction through the portal circulation in the liver, either by compression of the portal capillaries by cirrhosis, &c., or pressure in the portal trunk by enlarged glands, tumours, &c.; (B) as part of a general congestion due to obstruction at the right side of the heart from tricuspid dilatation. Due to the very direct communication of the veins of the chylopoietic viscera and the right auricle, these organs are among the first to experience the effects of the cardiac obstruction. Congestion of the alimentary canal and glands, when due to either of these causes, is in the main progressive in its nature, though occasionally liable to temporary relief from treatment.

Extreme conditions of vascularity, especially if associated with any hæmorrhage into the sub-epithelial tissue, present post-mortem appearances often mistaken for irritant poisons.

3. *Results of Increased Vascularity.* — (*α*) *Hæmorrhage.* Over-fulness of the capillaries, from whatever cause, is liable to lead to extravasation of blood, either by diapadesis of the corpuscles and transfusion of the fluid part of the blood, or from actual rupture of the vessels. It is much more common and far more extensive in venous congestion than in arterial hyperæmia. It must not be too readily assumed *post mortem* that either of these conditions alone is the cause of the hæmorrhage, since minute ulcers of the mucous membrane communicating with main vessels have been met with. Dependent on the course and situation, the effused blood may vary in colour from bright red to a coffee-ground appearance. Hæmorrhage due to altered states of the blood is of frequent occurrence in purpura, scurvy, &c. (*β*) *Œdema.* An over-distension of the vessels, especially of the veins, if it be at all persistent, is invariably accompanied by an effusion of serum into the substance of the viscera themselves and into the alimentary canal, in the latter case producing diarrhœa. (*γ*) Tissues the seat of a chronic congestion in time undergo certain structural changes as the result of their impaired nutrition, which are characterised by the presence of an excessive amount of connective tissue, containing fewer protoplasmic elements than normal, and exhibiting a marked tendency to contract. The fibroid substitution may occur throughout the entire digestive system, but is particularly noticeable in the stomach, intestines, liver, and pancreas.

4. *Anæmia.*—The alimentary viscera, in common with the rest of the body, may share in a general bloodlessness due to excessive loss or extreme malnutrition from wasting disease, &c. A deficiency of blood limited to these organs is not clinically met with.

5. *Infarctions.*—As compared with the brain, spleen, and kidneys, the organs of the alimentary system would appear to be less prone to suffer from emboli and thrombi, or at all events from the effects of their conditions. A partial exception to this general statement must be made in the case of the liver, which is a frequent seat

of abscess determined by the arrest in the portal capillaries of septic particles taken up by the portal radicals in dysentery, &c. Emboli, as a cause of gastric ulcer, are probably not so common as has been supposed by Virchow.

II. **Structural Affections.**—1. *Inflammation.* This term is applied to express those changes which take place in the nutrition of a tissue subsequent to the application of some abnormal stimulus which shall not have been sufficiently powerful to produce destruction. The changes in the structural elements of the textures result in the production of some material which is unlike the normal constituents of the part affected, and also in certain destructive phenomena. One or other of these aspects may predominate, as in suppuration and abscess or ulceration, &c. Certain variations present themselves in the nature of the new-formed material, and also in the general course of the process, constituting forms of inflammation, as simple, diphtheritic, phlegmonous, aphthous, &c. In vascular tissues there are in addition to the tissue-changes certain alterations in the circulation in the affected region, commencing with hyperæmia and leading to a variable amount of stasis.

Inflammation as it affects the alimentary tract offers no exception to this description. The transition, so far as anatomical appearances are concerned, from the normal state of activity of the organs, with their increased vascularity and cloudy appearance of the epithelial cells, to that of simple inflammation or catarrh, is but a step marked by no abrupt line. The entire canal, with the gland-ducts opening into it, may be the seat of various forms of inflammation, some regions being rather more prone than others, as the fauces, stomach, small intestine, and bile-ducts.

It is rare in inflammation of the canal for the muscular tissue to share in the process, which is practically limited to the epithelial and sub-epithelial connective tissue, and a similar condition exists in regard to the ducts of the various glands. It is a noticeable fact that the epithelia of the canal are but little prone to manifest that general suppurative form of inflammation accompanied by a large production of pus from the general surface, such as is so commonly seen in the bronchial, nasal, vaginal, and other mucous membranes. In inflammation of the various glands it would appear that next to the ducts the connective-tissue stroma is mainly the tissue affected, leading to a proliferation of the corpuscles and ultimate formation of a less protoplasmic form of fibrous tissue.

Among the chief results of inflammation are:—

(*α*) *Abscess.*—This may occur in any part of the submucous tissue, in the so-called phlegmonous and pyæmic inflammation, but is of most common occurrence in the tonsils and in the liver, often in the latter situation the result of inflammation determined by absorption into the mesenteric veins of septic particles from dysenteric ulceration.

(*β*) *Ulceration.*—The mucous membrane of the alimentary canal is particularly liable to this morbid process. Some preference is exhibited by the different forms of ulcer for certain regions of the canal, and a difference exists in the tendency to perforate the entire thickness of the tube, those of shorter duration frequently producing this result, whilst the chronic ulcers are usually accompanied by a slow formation of indurated connective tissue, which proceeds *pari passu* with the destructive process, and is especially likely to institute adhesions between the canal and adjacent organs. Ulcers are met with in the salivary, hepatic, and pancreatic ducts, very frequently as a sequence of inflammation determined by the passage of calculi.

The ulcers which are usually acute in their course are:—1. Simple. 2. Aphthous. These forms, though they may occur in any part of the mucous membrane, are far more commonly situated in the gums, cheeks, tongue and palate. 3. Acute specific ulcerations, as diphtheritic and scarlatinal, mainly affecting the fauces; or typhoid, limited to the jejunum and ileum, and originating in the solitary and agminated glands. 4. Dysenteric.

The ulcers that are commonly chronic in their course are:—1. Gastric. 2. Tubercular, which may occur in any part of the canal, but are usually limited to the same situation as the typhoid. 3. Syphilitic, most common in the mouth, fauces, and rectum. 4. Cancerous. 5. Dysenteric.

Ulcers, the result of injury or of corrosive poisons, may be either acute or chronic. The latter are rarely met with below the stomach.

(*γ*) *Sloughing and Gangrene.*—The inflammatory state may be so intense as to lead to molar death of the area affected, with the production of slough. This often follows scarlatinal inflammation of the fauces, and the surface of the large intestine in dysentery is frequently covered by large and numerous sloughs.

Gangrene is almost entirely limited to the mouth in children, when it produces the condition termed noma. The cheeks are usually affected first, the process rapidly involving the gums, jaws, &c. The cause is very obscure.

Post-mortem softening and destruction of the stomach and intestines is frequently met with, and is due to an actual digestion of the viscera by the gastric juice, which, thus escaping from the stomach, may cause destruction of adjacent organs. It is usually met with when death has occurred during the process of gastric digestion, and is more common in infants, possibly from the greater acidity of the products of digestion (lactic acid).

2. *Hypertrophy.*—A general overgrowth of the normal tissues of the digestive organs is practically unknown. Certain parts may manifest this condition, notably the muscular tissue of parts of the canal above an obstruction. The liver is described as being occasionally hypertrophied in certain cases of diabetes.

3. *Atrophy.*—The alimentary organs may share in the general atrophy and wasting of old age or inanition. This condition is apt to follow the disease of certain parts, as is seen in the thinning and shrinking of the stomach and intestines beyond an obstruction or an artificial anus. Pressure on the organs, as by tight-lacing, &c., may lead to the same result.

4. *Degenerations.*—Those morbid processes to which the term degeneration is applied, and

which essentially consist in the conversion of the tissues into materials of a less complex chemical composition than normal, associated with a diminished vital activity, may affect any or all of the structural elements of which the digestive organs are composed. Albuminoid infiltration or cloudy swelling is the invariable accompaniment of inflammation of the epithelial and muscular tissues. Fatty degeneration is a further result of inflammation, with caseation and occasional calcification. Although not the commonest organs to be so affected, yet not infrequently the intestine and stomach are the seat of the so-called amyloid or lardaceous degeneration, and not always limited to the vessels, but affecting the epithelial, fibrous, and muscular coats. The liver is especially liable to undergo degeneration, both fatty and albuminoid. Deposition of pigment may be found in the deeper epithelial strata of the mouth in Addison's disease, and in the liver in certain cases of intermittent fevers.

5. Changes in the secretions of the various glands may result in the production of *calculi*—salivary, pancreatic, or biliary.

6. *New Growths.*—There is scarcely any known form of neoplasm which may not be found in some region or another of the alimentary tract.

The new growths limited to the epithelial coat, or commencing in it, are condylomata, papillomata, encephaloid, and scirrhus.

In the fibrous tissue occur sarcoma, fibroma, myeloid, adenoid, gumma, enchondroma, and lipoma.

In addition there may be polypi, or tumours of the mucous membrane; myxoma; muscular tissue tumour; cysts; and vascular growths, such as nævi and hæmorrhoids.

7. *Traumatic.*—Certain parts of the alimentary tract are, from their position, more liable than others to external injury. Incised and punctured wounds of the mouth, œsophagus, stomach, intestines, and liver are of occasional occurrence, and rupture of the abdominal tissue is sometimes met with. The injection of corrosive substances may produce destruction of certain parts of the canal, and wounds may be determined by foreign bodies, as pins, fish-bones, &c., which have been swallowed.

III. **Malformations and Malpositions.**

1. *Hereditary.*—Of these the most important are hare-lip; cleft palate; fistulous communication between the pharynx and the exterior, or between the gullet and trachea; intestinal cæca; imperforate anus; herniæ.

2. *Acquired.*—Malformation and malposition of the viscera may follow from disease. Communications between the stomach and intestines, or between different coils of intestine, or between the gall-bladder and the gut, may result from chronic ulceration. Many herniæ are not developed until long after birth, from violent strains, &c.

Stricture of various parts of the canal is frequently associated with the healing of ulcers, and with new growths. Dilatation of the canal is apt to occur in the proximal, and contraction on the distal side of such strictures. The intestines may be considerably displaced from adhesions following peritonitis. Twists (volvulus), intussusception, internal strangulations, and prolapsus ani, are more or less common affections of the intestines.

IV. **Abnormal Contents.** — Concretions, chiefly of phosphate of lime, are found occasionally in the intestine. They usually are made up of consecutive layers of material deposited by the mucous membrane. They frequently have as a nucleus some foreign body. Similar bodies formed of chalk or magnesia which has been swallowed have been met with. Foreign bodies, such as pins, bones, fruit-stones, coins, &c., may also lodge in the alimentary canal.

Parasites.—The chief of these are Sarcina ventriculi, in the stomach; Tænia solium; T. mediocanellata; Bothriocephalus latus; all inhabiting the small intestines. Tænia Echinococcus (hydatid) in the liver. Ascaris lumbricoides, chiefly met with in the small intestines; and Oxyuris lumbricoides (threadworm) almost confined to the rectum. A few other species are rarely found.

The gases of the intestines may be so largely increased in quantity as to constitute an abnormal condition.

W. H. Allchin.

DILATATION (*dilato*, I enlarge).

Ætiology.—Dilatation of any of the cavities, tubes, or orifices of the body may either result from increased pressure from within, or from diminution in the resisting power of the walls of the tubes or cavities. These two causes are frequently combined, and, indeed, the latter is often the result of a long continuance of the former. Increased pressure from within may be due either to increased secretion of the normal contents of the cavity, or to some other effusion into it. This is the usual cause of dilatation of the closed cavities of the body; we have examples in the ventricles of the brain, the pericardium, the synovial cavities, the bursæ, the follicles of the thyroid body in cystic goitre, and the Graafian vesicles in some forms of ovarian dropsy. In the various tubes of the body, increased pressure from within may arise from obstruction, and the consequent accumulation behind the seat of obstruction of the substances which it is the function of the tubes to transmit.

Varieties and Characters.—1. *Cystic dilatation.*—In tubes which begin by blind extremities the result of dilatation is generally the formation of a cyst, and this is the usual mode of origin of the large class of *retention-cysts*, or *cystic dilatation.* We have examples in the sebaceous cysts, in the cysts of mucous membranes due to the ducts of the mucous glands becoming obstructed by the products of catarrhal inflammation, in cysts of the kidney formed by dilatations of the Malpighian capsules and uriniferous tubules, and in dilatations of the gall-bladder, and of the pelvis of the kidney.

2. *Uniform or cylindrical dilatation.*—In tubes not beginning by blind extremities, the effect of the obstruction is usually to produce a *uniform* or *cylindrical*, and not a cystic dilatation; though sometimes one part of the wall will yield, and so cause a diverticulum or sacculus. These uniform and cylindrical dilatations may occur in all the tubes of the body. They are met with in the

œsophagus and all parts of the digestive canal, in the heart, veins, bladder, ureters, bile-ducts, &c. This form of dilatation may be attended either with thickening and hypertrophy, or with thinning and atrophy of the walls. Usually, when the tubes are in the main muscular, hypertrophy occurs, from increased exercise of the muscular fibres in their efforts to overcome the obstruction; but when the walls are mainly fibrous or elastic, they generally become atrophied and thinned.

3. *Compensatory or collateral dilatation.*—Another form of dilatation from increased internal pressure may be termed *compensatory* or *collateral* dilatation; it is produced by the tubes having to transmit an increased quantity of fluid in consequence of the obstruction of other channels. Besides the blood-vessels, we may meet with examples of compensatory dilatation in one ureter when the other is blocked, and in the bronchial tubes and other parts. Resembling this form in its mode of origin is the dilatation caused by tubes having to transmit substances of too large a calibre, as, for example, in the passage of calculi down the gall-duct and ureters.

4. *Dilatation from changes in the walls.*—The last class of dilatations consists of those due to diminished power of resistance in the walls of the tubes or cavities. The most important examples of this class occur in the circulatory and respiratory systems; in the heart from fatty degeneration; in the arteries from atheromatous changes. In the respiratory organs it occurs both in the bronchial tubes and in the air-cells. Here, however, the loss of resisting power is itself usually caused by prolonged increased pressure from within; which in the air-cells, as their walls are elastic and not muscular, rapidly causes atrophy, and subsequent dilatation.

W. Cayley.

DILUENTS (*diluo*, I wash or dilute).

Definition.—Remedies which increase the proportion of fluid in the blood.

Enumeration.—Water is the only real diluent. It is given for this purpose in various forms—soups, ptisans, barley water, toast and water, milk, lemonade, aërated waters, &c.—to quench thirst, and increase secretion.

Uses.—Diluents are employed to lessen thirst, as in fever and diabetes. As the thirst may depend upon local dryness of the throat, as well as upon general want of fluid in the system, the power of water to quench thirst may be greatly increased by adding to it a little vegetable or mineral acid, or some aromatic, such as lemon or orange peel, which will stimulate the flow of saliva, and thus tend to keep the mouth moist after the liquid itself has been swallowed. The thirst-quenching power of water is also aided by the addition of mucilaginous substances, such as oatmeal, or linseed as linseed-tea, which, leaving a mucilaginous coat on the inside of the mouth and pharynx, retard evaporation, and thus lessen the dryness of the mucous membrane.

T. Lauder Brunton.

DIPHTHERIA (διφθέρα, a skin).—Synon.: Fr. *diphthérie, diphthérite*; Ger. *Diphtheritis.*

Definition.—A specific, contagious, asthenic, general disease, which sometimes prevails as an epidemic, and is endemic in certain places. It is characterised by the exudation in various situations—particularly on the mucous surface of the soft palate, uvula, tonsils, pharynx, larynx, and trachea—of a peculiar cacoplastic lymph, which, together with epithelial cells, generally forms a thick, tough, and stratified pellicle or false-membrane—a stroma made up of mucous and epithelial cells, arranged in layers of the cacoplastic exudation.

Name and Synonyms.—In 1826, Bretonneau of Tours, in his work, entitled *Recherches, &c. sur la Diphthérite*, created the name, and first pointed out the true pathology of the disease. In his latest memoir (1855) he substituted the term *diphthérie* for diphthérite, having discovered that the disease is not of an inflammatory character. *Diphtheria* was a word almost unknown in English medical literature till 1859, when the Sydenham Society published a volume of memoirs on the disease, translated by Dr. Semple from the French of Bretonneau and others. The name, slightly modified, has now been appropriated by all European languages; and at present there is no other word which can correctly be said to be synonymous with it, although it is equally true that the disease diphtheria has been described under many names, without, however, an exact appreciation of its distinctive character, by Hippocrates, Celsus, Sydenham, and others, from the dawn of medical history to the present day. 'Croup,' in cases named and described by Home, Cheyne, West, and others, is identical with Bretonneau's 'croup,' which he also calls tracheal and laryngeal diphtheria; but, nevertheless, croup and tracheal diphtheria being described by the majority of British authors as different diseases are not in a literary sense synonymous terms.

Geographical Distribution.—Epidemics of diphtheria have occurred in many countries far apart from one another, and differing essentially in physical features and climate. In recent years the geographical distribution of the disease seems to have become greatly extended, a circumstance which is probably attributable to the increasing intercommunication of peoples. Diphtheria has its favourite localities—localities in which it is always endemic, and frequently epidemic. Among such places may be particularly mentioned Florence and Paris.

Ætiology.—The disease is contagious. Apart from endemic and epidemic causes affecting its maintenance in foci, and its outbursts at particular times and in particular places, there are ætiological influences belonging to individuals in respect to:—

1. Accidental Predisposing Causes;
2. Age; and
3. Heredity.

1. *Accidental Predisposing Causes.*—Poverty and its concomitants—unventilated filthy lodgings, scanty clothing, and imperfect alimentation—impart to individuals a receptivity for the contagium of diphtheria. A similar receptivity exists in tuberculous persons and in all cachectic subjects. Scarlatina, measles, and whooping-cough peculiarly predispose to diphtheria. In twenty years, Barthez observed 605 cases of scarlatina: in 95 of them, that is, once in about

every six cases, diphtheria occurred as a secondary disease. Diphtheria of the air-passages may occur also as a secondary disease after a common inflammatory sore-throat, a circumstance which has led some to hold that diphtheria is an inflammatory disease. Recently-delivered women receive easily the diphtheritic poison. During epidemics the influence of the predisposing causes now enumerated is sometimes strikingly exemplified.

2. *Age.*—Diphtheria is most common between the ages of two and ten. Few persons are attacked after thirty; but there are occasional victims at all ages, from the earliest infancy to old age.

3. *Heredity.*—Diphtheria is not an hereditary disease; but a special aptitude to receive and develop the poison evidently pertains to certain individuals and families. This statement is borne out by the statistical enquiries of Morelli, Nesti, and others in relation to the recent epidemics of Florence; but the facts which establish it beyond a possibility of doubt are the numerous cases of particular families being desolated by diphtheria at intervals of years, and when the members attacked were widely separated. For example, a child died this year of diphtheria in Paris: a sister died of the same disease two years ago in Florence: about the same date, an elder brother similarly perished at the Cape of Good Hope: and the mother of these children was in childhood nearly carried off by the same disease. Family histories of this kind are so numerous, as to lead to the conclusion that there is often a certain stamp of similarity of constitution pervading a family, in virtue of which its members are specially disposed to receive and develop the diphtheritic contagium.

Natural Course.—Diphtheria has a tendency to run a definite course, as may be well seen in cases which are benignant or of moderate severity. In the cases termed *benignant* by authors—cases more numerous in some epidemics than in others, and commonly met with at the beginning and decline of most epidemics—the disease runs its entire course in from eight to ten days. In this class of cases complete and rapid recovery often takes place, not only without medical treatment, but also in spite of the most objectionable measures having been adopted. In many benignant cases the exudation is limited to the tonsils and pharynx, but sometimes it invades the larynx and trachea: nevertheless, under both circumstances, the false-membrane begins to loosen spontaneously, and to be got rid of between the fifth and seventh day. In cases of very malignant type—both in those which set in suddenly with intense symptoms, and in those which begin insidiously—the disease may run its course from health to death in less than one day, or, according to the greater or less severity of the poisoning, the fatal issue, or the dawn of recovery, may not occur for several days.

Incubation.—There is a great diversity of opinion as to the maximum period of incubation; but the general opinion is that it does not exceed a few days. There are facts and reasonings, however, which suggest the possibility of the diphtheritic poison remaining dormant in the system for weeks or months, till called into activity by favouring circumstances.

Invasion.—The invasion of the disease is generally occult and insidious. Slight fever, drowsiness, general discomfort, a little languor, loss of appetite, prostration, diarrhœa, rigors, pallor, tickling cough, husky voice, and hoarseness, often usher in diphtheria; but as these symptoms, separately or in conjunction, may occur in children from a multiplicity of causes, they assist in forming a diagnosis only when carefully studied in conjunction with one another, and with surrounding circumstances. It is, therefore, very difficult in most cases to fix the exact date of the commencement of the disease. Three or four days may be passed without the manifestation of characteristic signs, the patient during that time presenting no marked indications of seriously deranged health. The invasion-symptoms are sometimes so slight as entirely to escape notice. The disease may suddenly explode, without the smallest warning, by an attack of stridulous breathing; on looking into the throat we may then find false-membrane covering the tonsils and pharynx, and extending into the air-passages, so as dangerously to obstruct the passage of air into the lungs, and excite spasmodic exacerbations of dyspnœa. Sometimes, on the first, second, or third day of the disease, the patient is carried off before any exudation has taken place, the patient dying in a state of profound prostration from primary toxæmia. The diphtheritic poison sometimes kills without producing the diphtheritic pellicle.

Symptoms.—The symptoms of diphtheria are *general* and *local*.

The *general* symptoms of pharyngeal, laryngeal, and tracheal diphtheria are those of the general specific disease of which they are local manifestations. Wherever the false membrane is situated—whether on the tonsils, pharynx, larynx, trachea, bronchial tubes, nares, eyelids, vulva, vagina, uterus, anus, or on a wound, ulcer, or cutaneous abrasion—its nature is the same. The general symptom never absent is *prostration of strength*: the local symptom absent only in a very few exceptional cases is the *formation of false-membrane.* The other symptoms of most importance, but which are more or less frequently absent, are albuminuria, change of temperature, cutaneous eruptions, enlarged glands, and paralytic affections.

1. *Prostration of Strength.*—This is a constant symptom, but its degree is very variable. Some patients succumb to the primary shock of the poison. In rapidly fatal cases, however, there are degrees of rapidity—there is a gradation of cases from those in which death takes place in less than a day without any characteristic sign except prostration, to others in which time is afforded for the formation of false membrane, and the development of some or all of the symptoms mentioned above.

2. *Formation of False-Membrane.*—There is always an exudation of false-membrane unless the patient be cut off before there has been time for its formation. The nature of the false-membrane has been already briefly described in the definition of diphtheria. Its existence is

sometimes not discovered during life; as, for example, in those rare cases in which the exudation commences on the lining of the bronchial tubes, and occasions death by asphyxia before it has extended upwards to visible parts. As a general rule—with, however, about two per cent. of exceptions—the exudation begins on the tonsils or pharynx, and next, but not always in continuity, on the larynx. From one to five, six, or even seven days may elapse between the first appearance of false-membrane and its exudation on the mucous membrane of the larynx.

3. *Albuminuria.*—Albuminuria is very commonly met with. The third and fourth days of the disease are the most usual for the first appearance of this symptom; but it may occur on any day from the second to the twelfth without the occurrence being considered unusual. It is sometimes permanent for days, and sometimes continues for weeks after convalescence has begun. Its duration is from one to sixty days. It is often intermittent, and still more frequently—without quite ceasing—its intensity varies at different periods of the twenty-four hours. It does not necessarily indicate a morbid state of the kidney, and—unlike the albuminuria of scarlatina—it is not associated with dropsy. It originates in different causes, which sometimes operate separately or in combination. Probably the chief causes are the rapid waste of tissue and the altered state of the blood, which are very early effects of the poison of diphtheria; there consequently arises a sudden necessity for an enormous discharge of effete matter by the kidneys. Another cause, one likewise almost always in existence, is the ingestion of aliment much in excess of assimilative power; the intermittent character of this cause is probably the explanation of the frequently intermittent character of the albuminuria. A pulmonary cause of albuminuria frequently comes into operation, as in pneumonia, and during the death-agony from all diseases. Obstruction of the air-passages by false-membrane induces albuminuria by producing great congestion of the lungs with more or less asphyxia. Finally, a renal cause may occasionally exist in pre-existing disease of the kidneys; or, secondarily, in their simple congestion from the strain of the extra-work, and their functional feebleness through general deficiency of innervation. The proportion of cases in which albuminuria occurs for one or more days is about one in three cases; but the proportion is different in different epidemics. Albuminuria is not a sign of danger; its prognostic significance belongs not to itself, but to its cause or causes.

4. *Changes of Temperature.*—High temperatures prognosticate danger; but moderate or even normal temperatures are often met with in rapidly fatal cases.

5. *Cutaneous Eruptions.*—Eruptions, varying much in appearance, are sometimes seen in the course of diphtheria. They seldom continue more than three days, and are sometimes visible for only a few hours. If the eruptions themselves were the only guides to diagnosis, the malady might be often mistaken for scarlatina. The eruptions of diphtheria which simulate those of scarlatina are sometimes vesicular, sometimes like urticaria, and sometimes they occur in bright red patches—rubeolar, roseolar, or erythematous. They are not followed by desquamation, as in scarlatina. The appearance or non-appearance of these eruptions does not influence the prognosis. Ecchymoses due to blood-poisoning may also occur, and are of course of very serious import.

6. *Enlarged Glands.*—Glandular engorgement is often one of the earliest indications of diphtheritic poisoning. It is not a secondary result of the throat-manifestation, but belongs to the general disease itself. In the recent epidemics of Florence, described by Morelli and Nesti, turgescence of the cervical glands is mentioned as a symptom commonly associated with general anasarca, and an eruption of red, pink, and dark red points on the face, neck, chest, and abdomen. This eruption was sometimes visible for only a few hours, and never for more than three days.

7. *Paralytic Affections.*—This important subject is only named in this its natural place, its consideration being more conveniently reserved for a separate article. *See* PARALYSIS, DIPHTHERITIC.

DIAGNOSIS.—When diphtheria has proved fatal too soon to afford sufficient time for the manifestation of its characteristic symptoms; and also, when the invasion-stage is insidious, the diagnostic difficulties are great. Sanné believes that the affection designated 'throat-herpes' (*herpes guttural*) by Gubler is a form of diphtheria, an opinion which, if erroneous, is not easily controverted. The difficulty of the differential diagnosis fully explains an opinion, repeated by several authors, to the effect that the diphtheritic nature of an affection cannot be declared with certainty till the membranous deposit has been seen to extend from the tonsils and pharynx to the respiratory passages. Some physicians, among whom is Trousseau, think that the herpetic nature of the affection is established when an eruption of herpes appears on the lips. Sanné says: 'Diphtheria commences with local phenomena which are very varied: the form and disposition of the false-membrane are insufficient to enable us to predict the nature of the malady, or to form a prognosis regarding it.' He adds, and with truth, if the statement be accepted only as a provisional clinical fact: 'This is one of the most important aphorisms in the doctrine of diphtheria.' Pathologically, however, there can be no diagnostic difficulty in these cases if it be true, as an increasing number of physicians believe, that membranous sore-throat is always diphtheritic.

PROGNOSIS.—The younger the subject, the less are the chances of recovery. This arises from two causes, viz., the smaller power in infancy to resist depressing influences; and the narrowness of the larynx in infancy and childhood. The elements of prognosis belong in part to the individual case; and are in part common to all the cases occurring at the same time and place.

First, in respect to the individual element. The prognosis is unfavourable if false-membrane has been deposited, and continues to be formed on the mucous membrane of the air-passages during the first three or four days of the disease: on the other hand, the prognosis is favourable if these days be passed w thout formation of false-

membrane on the air-passages; but only *provisionally* favourable, for a sudden membranous invasion of the air-passages may occur during that period. If at the seventh day the air-passages be not invaded, if there be adequate cardiac power, and if a fair amount of aliment be regularly assimilated, the prognosis is very favourable. We must, however, take into account peculiarities of constitution, the presence or absence of disease prior to the attack of diphtheria, and also the exact significance of each symptom in respect to its individual gravity, its grouping with other symptoms, and the period of the malady at which the prognosis is made.

Secondly, in respect to surrounding circumstances. In cold damp weather the mortality is greatest. The medical constitution of the season, and the character of an epidemic greatly influence prognosis. In some epidemics, in which the local manifestation of the disease is limited to the pharynx, recovery takes place in nearly every case. In an epidemic which prevailed in France in 1847, the mortality was 91 per cent. In the first quarter of 1876 the mortality from diphtheria in the hospitals of Paris was 79·75 per cent., whereas in the six preceding years it averaged only 76·54 per cent.

Anatomical Characters.—The lesions found after death from diphtheria are *primary* and *secondary*. The *primary* are those found in persons dying during the natural course of the disease; the *secondary* are not direct results of diphtheria, but are consequent upon the complications and retardations of abortive convalescence.

1. *Primary lesions.*—In persons who die during the first two or three days of the disease, in whom there are no complications, and in whom there has not been time for the formation of false-membrane, the only morbid appearance found on dissection is sanguineous congestion of the mucous membranes, lymphatic glands, and internal organs. In those who live a few days longer, say till the seventh or eighth day of the disease, a similar state of congestion is met with; and there are found on mucous surfaces, particularly on those of the pharynx, larynx, and trachea, layers of the characteristic pellicle. The only primary morbid appearances of diphtheria, visible to the unaided eye, are congestion of organs, and false-membrane on certain mucous surfaces. To these has of course to be added a dyscrasia of the blood, which probably exists from the very beginning of the attack.

2. *Secondary lesions*, which are numerous, vary according to the nature and duration of each case. It is particularly noteworthy that in the secondary, anæmia replaces the hyperæmia of the primary morbid conditions.

To the general statements now made in reference to the morbid anatomy of diphtheria, there are numerous exceptions; and as one of the more important of them may be specified pseudo-membranous deposits in the bronchial tubes, and hepatisation of the lungs occurring as early as the second or third day.

A brief sketch of some of the secondary lesions of diphtheria is subjoined:—*Lymphatic glands.*—The submaxillary and parotid are the most usually and the most acutely affected: next in order of frequency come the superficial cervical glands, the deep cervical glands, and the mesenteric glands. Glands sometimes suppurate: when this takes place the pus is generally found in small circumscribed depôts. They are sometimes infiltrated with a brownish sero-sanguinolent fluid: sections of glands so affected resemble sections of the healthy spleen. *The inner ear.*—This is sometimes invaded by false-membrane, extending from the skin of the outer ear, or advancing by the Eustachian tube from the pharynx. *Connective tissue.*—Sanguinolent and sanguineous effusions are sometimes found in the connective tissue, particularly in that subjacent to mucous membrane coated with the diphtheritic pellicle. In it abscesses are also met with, in the contiguity of engorged and suppurating glands. *Muscular tissue.*—In protracted cases of paralysis, the muscles of the arms, legs, chest, and eye-ball are often found to be more or less in a state of fatty or waxy degeneration. The muscular tissue of the heart is likewise sometimes similarly affected. *Lungs.*—Besides the primary specific lesions we may find on dissection anatomical evidence of simple bronchitis, pneumonia, and pulmonary apoplexy having occurred as secondary affections. *Trachea.*—Cases have been recorded in which the trachea has been found ruptured, the result of a desperate struggle for breath. In tracheotomy-cases, the pressure of a badly adjusted canula has frequently caused ulceration of the trachea. The cicatrisation of the ulcer sometimes produces stricture of the passage. *Mediastinum.*—Abscesses of the mediastinum occasionally follow tracheotomy. *Kidneys.*—A form of superficial parenchymatous nephritis, resembling the characteristic lesion of scarlatinal albuminuria, is said to be a common pathological condition in diphtheria. Perhaps under the term *parenchymatous nephritis* many cases of simple hyperæmia are included. The condition of the kidneys in diphtheria requires, however, further investigation. The granular and other degenerations of the kidney described as having been met with, have probably no peculiar or direct relation to the diphtheria. They may either represent disease which existed prior to the diphtheritic attack, or disease resulting from the general damage to the system induced by that attack, just as it might have been produced by an attack of some other debilitating, blood-disintegrating malady. Be that as it may, it is important to note that in patients who die in the first days of an attack of diphtheria after having had intense albuminuria, the only discoverable morbid condition of the kidney is moderate or considerable congestion. Sanné explains the rarity of the occurrence of œdema and cerebral symptoms in connection with diphtheritic albuminuria by the fact that one kidney only is affected and not both, as in scarlatinous nephritis. *Nervous system.*—Even when death has been preceded by protracted paralytic affections, the most minute microscopic examination has generally failed to detect any morbid change in the encephalon or spinal cord. On the other hand, in protracted cases of diphtheritic paralysis, various alterations in the nervous periphery are frequently found.

Pathology.—Diphtheria is a poison-disease acting primarily upon the whole system; the exudation of cacoplastic lymph is a manifestation of the general poisoning, and not, as Trousseau taught, an infection of the patient by the absorption of the poisonous material of the false-membrane. Gangrenous decomposition of the false-membrane sometimes, however, becomes a source of secondary toxæmia. The poisoning is then not diphtheritic; it is simply the result of the absorption of putrid matter.

Treatment.—Few diseases more severely tax the ingenuity and therapeutic resources of the physician than diphtheria. He has to devise and carry out innumerable little details—hygienic, dietetic, and medicinal—which do not admit of minute description, and yet upon the minutiæ of which success or failure frequently depends. The treatment must be carried out on a rational basis, no special trust being placed in nostrums, or in any of the so-called specifics announced in earlier and later times, and some of which are still recommended by honest enthusiasts of limited experience. It is requisite to pay the utmost attention to the hygienic surroundings of the patient. From the first it is necessary that decided and well-considered measures be carried out to support life, by the administration of alcoholic stimulants and of easily assimilated aliments. Medicines which have a depressing influence on the nervous system, or which tend to produce dyscrasia of the blood, are to be rigidly avoided. Prostration of strength and dissolution of the blood are conditions which exist to a greater or less degree in every case of diphtheria; and for that reason, the abstraction of blood, purging, and the use of alkalies, mercurials, and antimonials are inadmissible.

From first to last sustaining and recuperative treatment—alimentary and medicinal—is the great aim. If life be maintained for a certain number of days, nature, even in very severe cases, makes a decided curative effort: in other words, when the disease has run its natural course, there is a greater or less attempt at spontaneous recovery. The moment has then arrived when the physician can most usefully intervene with his culinary and pharmaceutical resources. It is his therapeutic opportunity. A somewhat varied and well-planned pepsinated aliment and ferruginous medication, which had up to that stage produced little benefit, will then wonderfully assist nature in accomplishing a cure.

The principal details of treatment may be considered under the following heads:—1. Hygiene. 2. Diet. 3. Stimulants. 4. Medicines administered internally. 5. Applications to the throat and air-passages. 6. Tracheotomy.

1. *Hygiene.*—The covering of the patient must be light; and yet such as to prevent loss of animal heat. The placing of one or more caoutchouc bags filled with hot water under the bed clothes, close to the patient, is a simple and an admirable method of keeping the body warm, and of enabling the windows to be opened from time to time, without risk, to relieve the distressing air-hunger, when there is obstruction of the air-passages, intensified by the close atmosphere of a badly-ventilated room. The temperature of the room ought to vary little, a temperature of about 60° F. being maintained. The patient ought to be carefully screened from currents of air, care being taken that free ventilation is not interfered with. A thermometer and a steaming kettle are indispensable in the room of the diphtheritic patient. After tracheotomy, the maintenance of good ventilation, combined with an equal temperature and a warm moist atmosphere, is a paramount necessity; and, in all cases, and in every stage of cases in which there exists diphtheritic sore-throat, it is important, as a means of moderating the paroxysms of glotto-pharyngeal spasm, that the air inhaled be soft and warm, and that the temperature be equable. Even in the rare cases in which throat-affection is absent, it is the duty of the physician to take the measures best calculated to secure such an atmosphere as has now been described, for the disease may at any moment manifest itself in the air-passages.

2. *Diet.*—Nutriment is urgently demanded; but it is useless—nay, it is mischievous—to push attempts at alimentation beyond very moderate limits, so long as the malady is in the ascendant. Assimilation is then very nearly at a standstill, as is shown by the rapid emaciation which goes on, even when large quantities of food are being put within the patient, and likewise also by the albumin which is passed with his urine. The albuminous urine of diphtheria arises from different causes; but, speaking in general terms, it is correct to say that it arises from no renal lesions, and is the expression of rapid waste of tissues and of the non-assimilation of food. Alimentation is the most important, and also the most difficult part of the treatment. Patients—even intelligent adults—often resolutely refuse food, and feel intense loathing, excited by the mere sight or mention of any alimentary substance, and the food taken is generally rejected at once by vomiting; or if retained it is very sparingly assimilated. To press food upon children in spite of their loathing of it is generally injudicious: to press it upon them in spite of their struggles is sometimes even dangerous, as the excitement and resistance takes more strength out of the already prostrate patient than can be compensated for by forcibly administered aliment. We ought to try quietly to get the child to take frequently small quantities of milk or beef-tea; and when we fail, we must give enemata of beef-tea and brandy.

The food given to diphtheritic patients ought to contain pepsine. The quantity administered must of course be proportionate to that of the food. In respect to the dose of pepsine, it is necessary to remember that genuine British *pepsina porci* is four or five times as potent a digestive as Boudault's pepsine, the mixture generally prescribed in France. Pepsinated pills of pounded raw beef, with a few teaspoonfuls of the expressed juice of raw or slightly roasted beef, are exceedingly useful in keeping patients alive while the disease is expending its immediately destructive powers. When the irritability of the stomach does not forbid the trial, strong egg-flips may be given. A strong egg-flip may be made by beating up together one teaspoonful of concentrated Swiss milk, one teaspoonful of

brandy, and two or three teaspoonfuls of water. To these ingredients, two grains of *pepsina porci* may be added. Patients who have moderately severe attacks of the disease, and convalescents, can generally take such semi-liquid aliments as panada and chicken *purée* [*purée à la reine*]. Occasionally, but not generally, patients can take cod-liver oil. Milk ought to enter largely into the diet of diphtheritic convalescents. In them, as in all convalescents, it is an admirable mainstay; but there are some few cases in which it does not agree.

3. *Stimulants.*—Diphtheritic patients emaciate rapidly; and together with, as well as before the loss of flesh, extreme prostration occurs. Under such circumstances, the liberal exhibition of alcoholic stimulants is imperatively demanded as the principal, and when food is rejected, as the only means of supporting life during the most critical period of the disease. This great crisis is not generally prolonged for more than a few days, but stimulants may require to be more or less relied on for a long time. Sometimes for hours or days it may be impossible to give anything more than stimulants, of which the best are alcohol in some form, tea, coffee, and the juice of meat. When all kinds of food and stimulants excite nausea and vomiting, it is necessary to discontinue for a time nourishing the patient by the mouth. For some hours—for from six to twelve hours—he must be fed entirely by the rectum, so that the stomach may have an interval of complete rest. In such cases it is a good practice to precede renewed attempts at feeding by the mouth, by one or two doses of creasote and oxalate of cerium. Both can be given in very small bulk, which is a great advantage; and no other gastro-sedatives act less as depressants of the general system. The ordinary so-called creasote of commerce is bad carbolic acid, which, in place of allaying, frequently excites nausea and vomiting. If pure creasote cannot be obtained, pure carbolic acid may be substituted for it. The creasote may be given made into pill with breadcrumb; and the oxalate of cerium either in the form of pill, or wrapped in moistened wafer-paper as a pulpy bolus. The proper quantity of creasote to give at one time is from half a drop to two drops, and of oxalate of cerium from two to four grains. In the twenty-four hours we may administer as a maximum, according to the age of the patient and the circumstances of the case, from six to eight drops of the former, and from twelve to sixteen grains of the latter. Of the crystals, liquefied by heat, one drop is given in a tablespoonful of thin mucilage. This may be repeated several times in the twenty-four hours. When the remedies now mentioned have failed, the nitrate of bismuth in two or three successive doses of ten grains each may succeed. There are cases in which the nausea is so urgent a symptom that it is impossible, by any medicines, to overcome it. We must then trust entirely to the application of warm poultices, sinapisms, or turpentine-stupes to the pit of the stomach. The hypodermic injection of morphia, or the administration of an enema containing hydrochlorate of morphia, is another method of allaying nausea and vomiting, in the gastric irritability of fever and other diseases, but which is only applicable in a limited number of cases of diphtheria, in those cases in which the asphyxia is far advanced and is advancing. The quantity of hydrochlorate to be administered in clyster depends much on the age of the patient. Sixty drops of the Liquor hydrochloratis morphiæ of the British Pharmacopœia may be given by the rectum to an adult, while from five to ten drops is a sufficient dose in clyster for a child under ten years of age. Besides allaying nausea and vomiting, such a clyster soothes, diminishes the severity of spasmodic dyspnœal paroxysms, and gives the sufferer rest.

4. *Medicines administered internally* are usually employed either to accomplish some particular object; or to exercise a curative influence on the general disease.

There is another special object for which internal medicines are given, namely, the detachment and expulsion of false membranes from the air-passages. For this purpose the administration of emetics has been considered by many as one of the essential parts of the treatment of laryngeal, tracheal, and bronchial diphtheria. Their use is unquestionably indicated in certain cases, yet the range of their utility is very limited. There are two circumstances which obviously limit the advantages obtainable by emetics; first, if administered at an advanced stage of the disease, or at any stage when there exists great prostration, the vomitive efforts excited must act most prejudicially when they do not produce the desired result of expelling the false-membrane from the air-passages—they must draw dangerously upon the waning strength of the patient, and diminish his chances of pulling through with the aid of tracheotomy. Herein lies a great limitation of the use of emetics, because the cases are exceptional in which the blockade of the air-passages is effectually relieved by vomitive action; and when no such relief is obtained, the violent efforts excited by emetics only produce unmitigated evil—a large withdrawal of remaining vital power. Again, unless the exudative stage of the disease be ended, the ejection of false-membrane affords only a brief temporary respite, for new layers are speedily deposited to replace those which have been thrown off. These considerations show the narrow limits within which benefit can be obtained from vomitive action, and how much evil may accrue to the patient when that action is violent. Should it be judged expedient to induce vomiting, the emetic selected ought to be one which generally acts quickly and certainly, and which if it fail to act will not produce dangerous irritation of the intestines or great depression of the system. Tartar-emetic must not be employed. Sulphate of copper, an emetic much recommended by Trousseau and others under the circumstances now being considered, is also objectionable, because if it does not promptly cause vomiting, it will be nearly certain to excite enteritis and formidable diarrhœa. Ipecacuan and sulphate of zinc are perhaps the safest emetics to administer to a diphtheritic patient.

The repetition of dose after dose of any emetic is dangerous practice in diphtheria. For example, we may give, without apparent effect,

successive doses to a semi-asphyxiated patient whose functional life is dormant; and seeing that we give him no relief in the way hoped for, we proceed as our last chance of saving him to admit air into the lungs by tracheotomy. Forthwith the vital powers awake, and the accumulated doses speedily act with violence—the patient has been saved by tracheotomy only that he may die of pharmaceutical poisoning.

Dr. Sanné (*Traité de la Diphthérie*, Paris, 1877) suggests that the recently discovered medicine apomorphia might be tried as an emetic in diphtheria. It possesses properties which seem to recommend it very specially in this disease. This drug is administered hypodermically. It acts very rapidly—in from three to five minutes: and supersedes or greatly reduces the duration of the period of nausea. It frequently succeeds when other emetics have failed to act. The advantages which it possesses are, therefore, facility of administration, rapidity of action, and less fatigue to the patient. The only objection to its general use is the difficulty of preserving it.'

Another suggestion of Dr. Sanné is noteworthy. He proposes that trial be made of jaborandi, given internally, as a means of producing detachment of the false membrane.

The medicines which have a curative influence on the general disease are few in number. Certain medicines—preparations of iron, for example, are, under certain circumstances, particularly useful in diphtheria.

Of the medicines which have had in their day repute as specifics, or as agents of high therapeutic value, but have now nearly ceased to be so esteemed, a few may be briefly mentioned. Bromine and its compounds, sulphuret of potash, copaiba and cubebs, chlorate of potash, sulphite of soda, chloride of sodium, carbolic acid, salicylic acid, chlorodyne, calomel, quinine, perchloride of iron, and many other medicines, have all been proclaimed as specifics, or at least as wonderfully potent in the cure of diphtheria. Perchloride of iron has a decidedly beneficial action under certain circumstances; but this action it possesses in common with other preparations of iron. It neither arrests nor modifies the character of the malady in its early and most perilous stages; but its utility is unquestionable as an adjuvant, when, in the natural course of the disease, a spontaneous curative tendency has begun to manifest itself.

5. *Applications to the Throat and Air-passages.*—With a view to detach, dissolve, or destroy false-membrane, a great diversity of topical applications have been employed. Trousseau, and those who wrote under his inspiration, strongly recommended destruction of the false-membrane by various caustics and solvents. In the (1868) edition of his *Clinical Lectures* which was in the press at the time of his decease, Trousseau insists that the topical treatment is pre-eminently the best treatment of diphtheria, adding that it is as much indicated in this disease as in malignant pustule. Fortunately this doctrine is no longer in vogue, and when topical treatment is still employed in France, it is now seldom by caustics or any irritating substances. Sanné, writing in 1877, expresses the general sentiment of French physicians when he says:—'Cauterization is now generally abandoned: it has serious drawbacks; it is dangerous: it is useless.'[1] The practice of attempting to destroy the false membrane by caustics and powerful solvents is unquestionably mischievous. It irritates the parts and increases the exudative tendency. The free application of the officinal glycerine of borax, by means of a camel's-hair brush, is at least harmless, and seems to loosen the membranous patches. Frequently, washing out the mouth with this preparation, diluted with from four to eight parts of water, is agreeable to most patients, and is useful from the local soothing which it produces. A very diluted solution of hydrochloric acid is equally innocuous, and as a mouth-wash is pleasant and cleansing. Lime-water and lactic acid, used separately or mixed, exercise a powerful solvent action on the false-membrane; and were it possible to apply them to it without their coming in contact with, and thereby irritating the contiguous mucous surface, they might be used with advantage, or at least with impunity. A small quantity of lactic acid added to an aqueous solution of pure glycerine or to the glycerole of borax — one part to fifty of glycerine — is a favourite topical application with some practitioners, and is one which may be used without fear of doing any harm. Catheterism of the larynx, and injection of solvents into the trachea, are now generally looked upon as objectionable measures. They still have, however, their advocates. Dr. Young of Florence states, as the result of large experience, that he has seen much benefit result from throwing into the throat every hour, by means of a ball spray-apparatus, a solution of three drachms of lactic acid in eight ounces of lime-water.

Notwithstanding much that has been written in a contrary sense, a careful review of the subject leads to the conclusion that very little advantage is derived from internal local applications, that they are often exceedingly mischievous, and ought never to be used without the greatest circumspection. They do not curtail or greatly modify the natural course of the general disease; and the local benefits which they can confer are limited to soothing the parts, and slightly diminishing the obstruction of the air-passages. Moist warmth applied externally to the throat gives much comfort and is in no way injurious. Only soothing, or at least non-irritating substances are admissible as internal applications. It must be remembered that topical applications can hardly ever be employed in young children without exciting resistant struggles, which agitate and exhaust the patient. The risk of incurring this danger often forbids their employment.

6. *Tracheotomy.*—Besides the perils of the general disease—prostrating toxæmia, difficult nutrition, and paralysis of the heart and respiratory muscles—the patient has the special risk of dying asphyxiated from obstruction of the air-passages by false-membrane. This terrible danger is one of very common occurrence. When nature and art have failed to remove or effectually lessen the mechanical impediment to the admission of air to the lungs, the physician has to decide whether there be any reason against his giving the patient

[1] Sanné: *Traité de la Diphthérie*, Paris, 1877; p. 419.

a chance of life by making an entrance for the air below the membranous obstruction. If this one remaining chance remain in any degree, however small, he is bound to offer it to his patient. Sometimes no such chance remains. What conditions exclude the possibility of saving life by tracheotomy? That is the question. It is not whether the case be a favourable one for operation; for every diphtheritic patient is an exceedingly bad subject for any surgical operation. The simple question is:—Does tracheotomy give the smallest chance of life to a patient who without tracheotomy must inevitably die from asphyxia? The answer to this question may, as a rule, be given in the affirmative, if the obstruction be not below the situation in which tracheotomy is performed. If this rule be followed, the operation will often be performed in very desperate circumstances—circumstances in which the probabilities of success are very small compared with those of non-success. When the pseudo-membranous affection extends to the bronchial tubes—when pneumonia exists—when the diphtheria is an immediate sequel of measles, scarlatina, or typhoid fever—when the asthenia is extreme—or when the patient is phthisical—the probability of the operation saving him is small; and yet, in most unfavourable examples of the classes now mentioned, success has been obtained.

John Rose Cormack.

DIPHTHERITIC.—Relating to diphtheria. The term is applied to the membrane formed in diphtheria; and it is also associated with certain symptoms occurring in the course of the disease, such as diphtheritic paralysis. *See* Croupous.

DIPLOE, Diseases of. *See* Skull, Diseases of.

DIPLOPIA (διπλόος, double, and ὄπτομαι, I see).—Double vision. *See* Strabismus.

DIPSOMANIA (δίψα, thirst; and μανία, madness). — Synon.: *Oinomania*; Fr. *Manie ébrieuse*, or *crapuleuse*; Ger. *Trunksucht*.

Definition.—An irritability of the nervous system, characterised by a craving, generally periodic, for alcoholic and other stimulants.

Ætiology.—This peculiar condition may be brought on by a course of intemperate drinking; but it is seldom the result of that cause alone, and it is not infrequent in persons who have never been intemperate previous to the development of the morbid craving. The occurrence of this form of insanity, as of other degenerative nervous diseases, may generally be traced in the family history of the patients. But sunstroke, a blow on the head, or other direct injury to the brain may excite it; and it may be symptomatic of epilepsy, or of structural disease of the brain. It may be developed at any period of adult life; but most frequently declares itself during the pubescent and climacteric periods.

Symptoms.—An instability of character and indications of peculiar nervous irritability may generally be recognised as having preceded the distinct development of the craving. It is also usual to find such persons as are predisposed to the disorder abnormally sensitive to the influence of stimulants. Sometimes very small quantities of alcohol produce appreciable intoxication. The duration of the periods of craving is variable; but most commonly they last one or two weeks. The remissions continue for periods varying from two to twelve months. During the period of craving the whole moral being is enthralled by the morbid desire; and the regard for truth, decency, or duty is generally altogether lost. Moderate indulgence in a stimulant may bring on the morbid craving; but the desire is frequently developed without any such introduction. Members of the household in which a patient lives can indeed often recognise the indications of a coming attack by a restlessness and depression which precedes any such indulgence. During the intervals the patient seems, except when the brain has been weakened by frequent attacks, to recover completely; and he generally displays great confidence in his ability to resist the tendency in future. Repeated attacks always produce a permanent degradation, both intellectual and moral; and if the patient live long enough he lapses into a state of dementia. It sometimes happens that some cerebral lesion, of which the dipsomania had been symptomatic, manifests itself in paralytic or convulsive symptoms; and the appearance of such phenomena is often accompanied by a modification of the craving.

Diagnosis.—True dipsomania may easily be and often is, confounded with mere habitual drunkenness. In dipsomania, however, there is, as a fundamental condition, a pathological condition of the brain which manifests itself irrespective of external circumstances of temptation. In habitual drunkenness the craving consists mainly in a desire to keep up a condition of stimulation to which the brain has become accustomed. The habit is the result merely of compliance with a vicious custom, and there is no such periodicity or independence of external influences in the symptoms as is found in the true disease.

Treatment. — Prolonged abstinence from stimulants, and adherence to the tonic regimen, are the only measures from which any amelioration can be hoped for. It is seldom possible to restrain the gratification of the craving without seclusion in an asylum or some similar institution; and even when such compulsory restraint has been successfully enforced for a considerable period, the morbid tendency is seldom eradicated. The present state of British law does not, however, permit us to confine either the dipsomaniac or habitual drunkard unless something more morbid than an abuse of stimulants can be alleged. And it is difficult to see how a law could be enacted which would be effectual without being open to serious abuse. Public attention has, however, been lately very earnestly directed to the subject, and it may be hoped that something will be done towards rendering efficient treatment possible.

John Sibbald.

DISCRETE (*discerno*, I separate).—This adjective is used in reference to certain cutaneous eruptions in which the spots or pustules are separate from each other; for example, discrete small-pox.

DISCUTIENTS (*discutio*, I drive away).

Definition.—Local applications, which are supposed to remove the congestion and effusion of inflamed parts, and the swelling of the skin over them.

Enumeration.—The chief discutient measures or agents are:—Friction; Pressure; Mercury and its preparations; Iodine and its preparations, including the Iodides of Potassium, Lead, and Cadmium.

Uses.—These remedies are generally applied over enlarged joints, enlarged glands, or cystic tumours. The most powerful amongst them are mercury and iodine and their preparations, either alone or in combination. Their action is aided by heat and pressure. The effect of the former is seen in the Indian treatment of goitre, which consists in rubbing iodide of mercury ointment over the tumour, and exposing the patient to the full rays of the sun, or to the warmth of a large fire. The beneficial effects of pressure are observed in the diminution which takes place in enlarged and swollen joints under the application of mercurial ointment or strapping, the friction with the hand in applying the ointment, and the pressure exerted by the strapping greatly increasing the efficacy of the mercurial preparation in removing swelling. *See* Friction.

T. Lauder Brunton.

DISEASE (*dès*, from, and *aise*, ease).—Fr. *Maladie*; Ger. *Krankheit*.

Definition.—Disease may be defined as a deviation from the standard of health in any of the functions or component materials of the body. *See* Pathology.

The expression 'a disease' is frequently used with reference to a supposed unit of causation. Thus, it may be applied to some simple phenomenon, for example, neuralgia, when that phenomenon is the sole effect of a cause; or it may include many concurrent or consecutive resultant phenomena, such as those of syphilis or typhoid fever.

General Considerations.—It is well known that changes of function and of structure are brought about and influenced by a great variety of agencies. These agencies, some of which act from within, others from without, are recognised as the *causes* of disease. Such changes, whether they be functional, affecting more especially the vital properties of the body, or structural, affecting its physical properties, constitute what is familiarly known as Disease, which is hence called respectively *functional* or *structural*. These changes are merely the evidence of an altered or perverted action, which is then in operation or has already occurred, the nature of which is considered under the head of *pathology*. When these deviations from health can be recognised during life they are described as the *symptoms* or *signs* of disease. For example, when a person, after exposure, it may be to wet or to cold, or both, is found to have an increased temperature, with a quick pulse and perverted secretions, and to complain of thirst, and pain at the joints with effusion in and around them, we say that such person is labouring under disease, and we call it 'rheumatism,' because that name has been assigned to a complexus of deviations from health, such as those then presented by this individual. When typhoid poison has been introduced into the body, it leads in like manner to a number of functional and structural changes, which, taken together, constitute what we call 'typhoid fever.' Or again, under certain circumstances there appears to be generated in the system, whether as the result of a tendency acquired before birth or by habits of life, an agency which, acting morbifically, produces a series of phenomena which we call 'gout.' These several forms of disease may be *classified* in groups, arranged in accordance with the causes which give rise to them, their nature, their seat, their duration, &c. Rules are laid down for the modes of distinguishing or *diagnosticating* one disease from another; for *prognosticating*, as far as may be, their result; and for their *prevention* and *treatment*.

Thus it comes that the discussion or description of any *particular disease* consists of an account of the causes that give rise to it, or its Ætiology; the changes of structure or of function which constitute it, that is, its Anatomical Characters and Pathology; the phenomena attending these changes, otherwise, the Symptoms and Signs of the disease; the facts that serve to distinguish this particular disease from other diseases, that is, its Diagnosis; the means of forecasting its progress and termination, which constitute its Prognosis; and finally the measures by which it may be prevented, relieved or removed, that is, its Treatment. Throughout this work the various diseases are, as far as may be practicable, discussed upon this uniform plan.

As thus understood—and it is well to remember it—Disease is an abstraction or relation, and not an entity having a special and independent existence. Physiology has in recent days diffused a clear and penetrating light over many of the processes of life in health, which were previously dark and obscure. Pathology, which is physiology applied to the study of unhealthy function and structure, anxiously follows the footsteps of the sister science. We are therefore not hoping and believing too much when we express our conviction, that the time is not remote when we shall be able to trace those early and minute changes which constitute disease, and the causes which give them origin, and that we shall thus be enabled to define in a more philosophic and practical form what disease really is. In the meantime we must be content to work upon the phenomena before us, to investigate so far as we can the causes of disease, how to recognise its presence and its nature, how to estimate its progress and its duration, and finally how to prevent its occurrence or to cure it when it has occurred. These varied and important points will be found discussed as above stated under suitable headings, in the articles immediately following, and in other parts of this work.

R. Quain, M.D.

DISEASE, Causes of. — Definition. — Whatever is capable of damaging the structure of any organ or tissue of the body, or interfering with its function, may be a cause of disease. This definition implies that such causes are numerous, and that of many science is yet ignorant. To give a succinct account of them

is therefore difficult, nor is this difficulty diminished by the fact that, in most diseases, we can trace a succession or combination of causes.

General Classification. — The causes of disease have been divided into (1) *Predisposing* or *Remote*, (2) *Exciting* or *Proximate*, and (3) *Determining*. Illustrations will explain what is meant by these terms:—Two individuals are exposed to the contagion of typhus in equal degree; one, wearied by bodily and mental labour, 'catches' the disease—that is to say, his condition has *predisposed* him to the exciting cause of the malady; the other, in vigorous health, escapes the contagion—the *exciting* cause of disease. Predisposition in fact *prepares* persons by rendering them more susceptible to the influence of exciting causes of disease. Many persons are *predisposed* to emphysema because of hereditary taint; in them the air they breathe is day by day an *exciting* cause of this disease; they contract a bronchitis which, by its attendant cough, *determines* the malady. Such illustrations might be extended to a multitude of diseases, and justify the division of causes which the older physicians made. Predisposition may be inherited; or it may be acquired, and be due to various accidental causes. In most cases there is a combination of predisposing causes; in a man, for example, lowered by fatigue, want of food, and exposure, debauch will readily excite an attack of bronchitis or pneumonia. Practically, it is often difficult to say how much is due to predisposition, but, though many factors unite in the predisposition to disease, it is possible in most cases to estimate the part played by each. *See* Predisposition to Disease.

Moreover it is not always easy to distinguish predisposing from exciting causes. Predisposition carried to excess becomes an exciting cause of disease, and in many cases there is a combination of both. There are certain distinct exciting causes—for example, heat, cold, or injuries of various kinds, but most of these can claim a predisposing power. The contagia of the acute specific diseases and parasites are good examples of direct exciting causes.

In proceeding to discuss the subject of Ætiology, no attempt will be made to separate definitely predisposing from exciting causes of disease. The writer will endeavour rather to indicate as far as possible under the head of each factor of causation the direction in which it especially acts.

1. Age.—This has a most important influence as a predisposing cause of disease. In Wagner's *Manual of General Pathology* the periods of age are thus subdivided:—

(1) Nursing age (infancy)—from birth to 7th–10th month.
(2) Childhood—from 1st to 2nd dentition.
(3) Boyhood—from 2nd dentition to puberty.
(4) Adolescence—from puberty to 20th-25th year.
(5) Early manhood—from 25th to 45th year.
(6) Later manhood—from 45th to 60th year.
(7) Old age—from 60th onwards.

This division is excellent, but in no definition is there more need to look out for exceptions than in that of age. The term *age* is strictly comparative; some individuals are old at forty, others young at sixty. Persons fail with regard to particular organs while young in years; and, on the other hand, others acquire an increased power in the same as years advance, of which the brain affords an apt illustration. The minor organs of the body betray the like peculiarities, and in the early decay of the teeth, the changes in the hair and the skin, we meet with indications of old age, though the individuals are young in years. But, generally, the predispositions of the young and old are striking by their contrast. The young are exempt from fatty degenerations, which are so common amongst those of advanced life, and, in consequence, many diseases amongst them are, *cæteris paribus*, less deadly; and not only does age, by reason of the changes which naturally occur as life goes on, predispose to disease, but all outward conditions become changed. Children—speaking generally—are apt to suffer from acute catarrhal affections of the mucous tracts, glandular diseases, skin-diseases, tuberculosis of acute type, scrofulosis, and a variety of complaints traceable to improper feeding, bad ventilation, overcrowding, and to hereditary taint. From acute tuberculosis the aged are almost entirely exempt, and they do not suffer from hereditary taint nearly so frequently as the young. The very young and the very old are equally subject to bronchial catarrh, and the mortality from this disease at each extreme of life is exceedingly great. But in the young the predisposition to this affection is almost invariably associated with a predisposition to catarrh of the intestinal tract, and to diseases which indicate a general constitutional depression; while in the old bronchial catarrh is predisposed to by a degenerative change in the lungs themselves, or in the air-passages. In childhood there is an active stage of growth and development, and when one important organ is affected the others suffer with extreme rapidity; the excito-motory system is greatly developed, and hence arises a predisposition to spasmodic diseases—for example, to laryngismus stridulus, and to general or partial convulsions during the excitement of dentition. In the old the tendency to spasm decreases, and convulsions become much less marked. Some of the exanthemata, especially measles, scarlatina, and pertussis, are more common amongst children than adults, which is partly explained by the fact that the latter class have passed through the ordeal of those diseases, and are thus proof against them. Rickets also is essentially a disease of infancy and early childhood.

The onset of puberty is a constant source of predisposition to disease, for with it comes a complete transformation in the mental and physical characters, so that the individual, if not very carefully watched, deviates from even the most perfect health into a permanent tendency to disease. The system at this period—especially in the case of females—is frequently unable to bear anything which interrupts or interferes with its activity. The generative organs undergo great changes, and with them the whole moral and physical nature is altered. At this period of life there is a predisposition to both bodily and mental diseases. In fact, perversions of any organ or faculty may be started, and, once started, they are apt to

continue; so that there is established, literally speaking, a permanent predisposition to disease, and this predisposition swells very largely the list of affections which are dealt with under the generic term Hysteria. Lung-affections—excepting pure bronchitis—are more common at and shortly after the time of puberty than in previous years; but, excepting in the instance of phthisis, hereditary taint is less manifested than during childhood. Even hereditary epilepsy is, if postponed beyond early years, likely to be postponed to the period of adult life.

As has been said, the degenerations of organs and tissues begin to show with much uncertainty, but after the fortieth year of life we almost invariably meet with one or other of them. Their degree and their consequences vary with the surroundings of the individual—with his habits, temperament, occupation, and like influences. Diseases of the large vessels are especially common at this epoch, such as aneurisms of the aorta and of the large arterial trunks in the extremities. Henceforward all the diseases peculiar to advancing age become common. The results of previous disease are now declared by a decided predisposition to exciting causes which have been hitherto withstood. Old age is a relative term. A man is old and predisposed to trifling excitants because his lungs have lost their elasticity, or his brain its regularity of circulation, or his heart its vigour—in each of these cases, as in a host of others, the predisposition is strictly one of degeneration. Again, inherited diseases do not declare themselves in some cases till the later years of life, and of this carcinoma is a striking example. The old are predisposed to lowering diseases—low pneumonia or bronchitis; and to a variety of nervous affections which the vigorous can resist. In them the failing heart-power tells a tale; they are the subjects of general vascular dilatation; and, in short, they succumb to insignificant exciting causes, because of the general or partial decay of the tissues and textures of the body.

2. **Heredity** is a prolific source of predisposition. There is amongst men not only an inheritance of such prominent diseases as phthisis, but of peculiarities in the manner they meet and pass through minor ailments. Thus, in families with a 'nervous history,' we meet with predisposition to headaches of nervous type, irregularities of digestion in the form of diarrhœa and vomiting, and a multitude of conditions which have of late been ascribed to vaso-motor disturbances. The members of some families live long in spite of exposure to almost every exciting source of mischief, and contrast most favourably with others who, as far as one can determine, have all things in their favour. There is no doubt that the effects of syphilis, malformations, gout, the hæmorrhagic diathesis, and tuberculosis are handed down from generation to generation. Of many minor complaints there is less certainty; but it is exceedingly probable that persons are predisposed to bronchitis and other catarrhs by inheritance. It is acknowledged that epilepsy descends from parent to child, and that, in fact, individuals, because of heredity, are often the subjects of nervous diseases excited by causes which those free from taint are enabled to throw off readily. The various forms of insanity are striking examples. It is supposed that the inheritance lies in the tissues themselves—that there is a something in the tissue-elements which predisposes to certain diseases in certain families. It has been asserted that there is even a predisposition by inheritance to the acute specific diseases—such as typhoid fever and diphtheria, and some remarkable occurrences in this country strongly bear out this view.

3. **Intermarriage.**—Intermarriage certainly predisposes to disease, but it is not easy to determine how far its predisposing powers extend. Breeders of first-class animals practise intermarriage, and thereby develop speed, quality, and endurance in the offspring. It is beyond question that this practice of breeders of race-horses is eminently successful for the time, but it by no means follows that the permanent results are good. We are bound to look not only to the immediate, but to the ultimate results of intermarriage—in short, to decide whether intermarriages predispose to disease, to the injury of the community. But no rule, free from exception, can be laid down on this subject, for beyond all doubt many intermarriages have led to both physical, moral, and mental advantages. There is no doubt that malformations are handed down, and that where these are marked in families it is injudicious for persons to intermarry. Where also, for example, serious diseases, such as phthisis, have been met with on both sides, it is most advisable that intermarriage should not take place.

4. **Sex.**—There are great differences in the organs and functions of the sexes, and in consequence a great contrast in their predisposition to disease. The female is more delicately constructed than the male, and those organs which the two sexes possess in common differ in weight and in 'fineness;' and a general consideration at once indicates that the female is less fitted than the male to resist many exciting causes of disease. This is particularly evident at climacteric periods of life; with the onset of puberty girls suffer far more than males, and especially from a variety of reflex spasmodic disorders, which require but little provocation for their development. All the phenomena classed under the head of hysteria often occur at this period. At the same time, and shortly afterwards, there is a tendency to ulcer of the stomach, to persistent constipation, to peculiar attacks of neuralgia—especially of the intercostal nerves, and to acute rheumatism, lapsing into the subacute or chronic kind. Anæmia and chlorosis are also common at the period of puberty, and if then neglected they are apt to persist, and predispose the individual still more to disease.

Even so early as the period of puberty the external circumstances of the sexes differ, and on this depends, in a certain measure, the difference in their predisposition. Education, domestic habits and customs, and, above all, occupation, play an important part. But, underlying these outside influences, there is inherent in the sexes a difference in predisposition; for when they are exposed, as often happens, to the same surroundings, they suffer from widely sepa-

raced diseases. Males are more subject to epilepsy, tetanus, gout, diabetes, locomotor ataxy, vesical diseases, and acute lung-affections, than females. The list shows that occupations which involve hard mental and bodily work and constant exposure explain some of the varieties in predisposition. It is probable that females are more frequently ailing than males, but very often their illnesses are associated with the menstrual functions, and are trifling in degree, and, though more males are born than females, towards the later years of life the average of the sexes becomes more equally balanced, because the mortality of males is greater than that of females. It is sufficient to allude to the fact that pregnancy and lying-in predispose females to diseases from which males are entirely exempt; and that there is a considerable difference in the sexes as regards venereal affections, both as to predisposition and the effects of that predisposition.

5. **Temperament** is important as predisposing to disease. Persons of *sanguine* temperament are disposed to congestions of organs, and hæmorrhages, on comparatively small provocation. *Phlegmatic* individuals are the subjects of those diseases which are readily excited by want of mental and bodily energy and activity. A third set belong to the *nervous* temperament; they are easily excited and easily depressed, so that excitants cause either a form of hysteria or hypochondriasis, for example. The predisposition amongst this class is constantly met with in diseases of an acute character. Nervous persons suffer quickly from delirium and other brain-symptoms, which aggravate and render dangerous an otherwise hopeful malady. In the acute specific diseases this is particularly manifested; nervous people are undoubtedly predisposed to them, and when once attacked are predisposed to dangerous complications. Practically we meet with 'mixed' temperaments, though one perhaps especially prevails. *See* TEMPERAMENT.

6. **Climate and Locality.** — These differ widely in their predisposition to disease. Persons who have been accustomed to a particular climate frequently suffer when transferred to one differing from it; and on the other hand the sick often benefit by change. Particular diseases flourish in particular climates, and particular organs suffer. In the tropics various endemic fevers prevail which are unknown in this country, for they cease to exist when the temperature sinks below a certain level (about 60° Fahr.). Frost very often cuts short epidemics in our own country in like manner. Particular organs are predisposed to disease by climate—the liver in the East Indies, the lungs and the kidneys in regions where the temperature is capricious. Climates differ as regards air—whether moist or dry, hot or cold; but besides these things the topography must be considered, and the elevation of districts. Plains, mountains, and valleys have various predisposing influences, and while much of such influence depends on the configuration of the country, no little is due to the nature of the soil. No better proof of the latter fact can be given than that yielded by the observations of Dr. Buchanan, who has shown that where a proper system of drainage of soil-water is carried out, the tendency to pulmonary diseases is very greatly diminished. Clay soils are cold and damp and favour diseases aroused by these combined agencies; sandy and gravelly soils readily drain themselves, are warm and dry, and thus far tend to protect those who live on them against disease. Climates are also modified by trees, rocks, rivers, lakes, &c. Detritus carried down by streams and deposited along their banks or at their estuaries, has, like ground vegetation and its decay, an undoubted predisposing influence. Particular districts also predispose to certain diseases. Cretinism is most common in close valleys; urinary calculus is endemic in many districts of Great Britain and elsewhere. In some circumscribed areas in Scotland, in Norfolk, and other districts, individuals are especially liable to stone. The influences of climate are well shown by the electric conditions of the atmosphere; some persons are so predisposed that they can foretell a thunderstorm by the change in themselves. Fogs in large cities depress most people; and it is not too much to say that many diseases may be traced to a predisposition which 'bad weather' has started. Alcoholism has been provoked in this way. It is clear, therefore, that under the head of climate there are many combining influences, which affect the moral, mental, and bodily nature of individuals, and through one or all may predispose to disease. In this country, and probably elsewhere, those who dwell on mountains are less liable to disease than the dwellers on plains; marshy plains especially predispose. It should be remembered, however, that it is not climate alone which varies the predisposition amongst persons residing in different regions, for their habits, diet, &c., differ far more than the climate in which they dwell, and predisposition to disease should never be ascribed solely to climatic conditions unless accidental influences have been investigated and eliminated.[1] *See* CLIMATE.

7. **Town and Country.**—The influences of town and country, as predisposing to disease, require a separate consideration. With them may be considered dwellings, and a variety of minor sources of predisposition. The mortality of country districts is less than that of towns, but towns differ in this respect amongst themselves. The health of the largest city in Great Britain, for example, compares favourably with any of the large manufacturing towns and with many rural communities. It is easy to understand that differences must depend on the occupation, food, and habits of the people, and on their external surroundings —air, light, drainage, and like conditions. In large towns occupations are more lowering than in country districts; while the physical and mental strain is greater, and has fewer interruptions. Late hours, intemperance, and prostitution prevail in towns; but it is by no means certain that, in proportion to the population, these ills are less frequent in the more remote districts. In towns overcrowding checks ventilation, makes

[1] Imperfect drainage leads to what are popularly known as 'damp walls' in dwellings, and thus predisposes to pulmonary diseases by interfering with ventilation—in fact, by preventing the admission of pure air into such dwellings. This truth bears out the teachings we have derived from Dr. Buchanan's investigations at Ely and elsewhere.

drainage difficult, so that subsoils become saturated, clouds the atmosphere with smoke and dust, intermingles the sexes (amongst the lower classes) so that succeeding generations are stunted in their development, and in a variety of other ways predisposes to disease. But in some towns these evils have been obviated by sanitary measures, and as a consequence towns often predispose less than country districts to diseases due to defective drainage and overcrowding. Some startling illustrations of this fact have occurred since sanitary science has been acknowledged to be of national importance. In villages, for instance, reputedly 'model,' epidemics of disease associated with defective drainage and evil domestic arrangements have decimated the inhabitants, and the virulence of these epidemics has been greater than that of those met with in large towns. The latter are now-a-days for the most part better drained than country districts; thus milk-epidemics of typhoid fever have been imported into large cities from isolated farms where the drainage alone seemed to be at fault. Amongst children, rickets, scrofula, and tuberculosis are far more prevalent in town than country. The mortality amongst young children is far greater in towns than country districts. Adulterations are an evil in large communities, affecting people of all ages. From many of these country districts are free, and especially is this true as regards milk. So while dwellers in the country may have bad drainage and bad houses, they have pure air as a rule, every opportunity of breathing it out of doors, and unadulterated milk. Even the alcoholised drinks in many country districts are home-made and harmless when compared with the adulterated raw spirits taken by the lower classes of large towns.

8. **Hygienic Conditions.**—One of the most common causes of disease coming under this head is want of cleanliness. To this is due a variety of skin-diseases, such as eczema of the scalp in children, diseases caused by pediculi, &c. It interferes with the functions of the skin generally, and by it even a common cold is modified. Clothing is a part of this subject. Insufficient clothing is a most important source of predisposition, amongst the rich as well as amongst the poor; for, though the climate of this country is so variable, corresponding adaptations of dress are for the most part neglected. Flannels worn day and night also predispose to disease. Clothing is used to prevent the loss of heat, which occurs in three ways —by radiation, conduction, and evaporation, and a careful adaptation enables us to modify these sources of loss in such a way as to obviate a predisposition to disease. There is probably more care taken in tropical climates to regulate the heat of the surface than in the temperate zones. A very common cause of predisposition to disease is neglect of proper bedding. Deficient ventilation and overcrowding are prolific sources of mischief. Overcrowding without ventilation is one of the greatest evils of our chief cities and towns; and not only is it in their homes and workshops that populations are overcrowded, but in their places of recreation, such as theatres, and in their places of religious worship. Briefly it may be said that overcrowding predisposes to moral, mental, and physical deterioration; to epidemic diseases, and especially to typhus fever; to pulmonary affections; and to a variety of nervous diseases. By lowering the *morale* of populations it increases all other predispositions, and, in fact, passes into an active exciting cause of disease.

9. **Occupation.**—This is a common cause of disease, and is often associated with want of proper hygienic conditions. The overcrowded in work-rooms breathe an impure air, an air loaded with carbonic acid, irritant particles, and various exhalations, and thus are liable to disease. Miners breathe an air laden with carbon; knife-grinders inhale fine particles of metals; marble-polishers and masons are in the same plight; in all three cases occupation, combined with neglect of hygienic precautions, leads to pulmonary diseases. Occupation is in many cases a direct exciting cause of disease; for example, workers in arsenic, antimony, copper, lead, the mineral acids, &c., suffer from the poisonous effects of these substances. But oftentimes they escape the direct influences, yet are subject to a predisposition to various diseases, as a consequence of their occupation. Various other occupations, such as those of tailors, shoemakers, milliners, and brain-workers, predispose to disease in different ways.

Too much work and too little work (mental or bodily) predispose distinctly to disease. Continued overwork reduces the system generally, and special organs in particular, according to its nature. A coachman, who uses for many hours his pectoral muscles in driving, suffers chiefly in them when he has an attack of muscular rheumatism. So also those who use the brain too much in intellectual work are predisposed to functional, and even to organic derangements of the nervous centres. Physical overwork is often conjoined with exposure and improper or irregular food-supply, and the combination has a marked effect. It has so predisposed armies to disease that their ranks have been decimated by fevers, pneumonia, and bronchitis, far more than by the cannon or by the sword. Not a few medical men have been affected by the contagia of the acute specific diseases, because when exposed to them they were worn out by bodily and mental exertion, and by protracted fasting. Over-work reduces the nervous power, and thereby strikes at the very root of the healthy status. On the other hand a sluggish use of the mind and body are favourable to disease, and some persons are so constituted that they cease to be safe when their minds have lost the opportunity of active exercise; and the very fact that they substitute an abnormal intellectual employment is proof of this truth. And what is true of the mind is true of the body. A sudden change from active bodily exercise to bodily laziness predisposes largely to disease.

10. **Air.** — The question of air has already been alluded to, in considering climate, occupation, town and country, overcrowding, &c., and it is scarcely necessary to dwell much more on its ætiological effects. Air influences the predisposition to disease according to its degree of rarefaction, moisture or dryness, warmth or coldness, and the impurities, mechanical or chemical, which

may adulterate it. In the article CLIMATE many of these atmospheric conditions are fully dwelt upon, and their tendencies explained. Impurities in the air are exceedingly prevalent; and mechanical substances suspended in it can excite irritable conditions of the air-passages which may pass on to inflammation, and even destruction of the lungs. Throat and laryngeal affections are a common consequence of these impurities. All these chiefly occur amongst certain classes whose occupation loads the air with fine particles as already described. There is scarcely a mineral used in the arts which cannot, by inhalation, excite or predispose to disease. The air may also be rendered impure by chemical agencies, and the moment the normal proportion of its elements is disturbed it becomes a source of disease. Excess of carbonic acid is especially an element of mischief —causing headache, dyspepsia, and nervous depression. The presence of ammonia and of sulphuretted hydrogen is attended by like results. The human economy is, however, so framed that its organs can often very rapidly throw off the evil effects of these gases when breathed in overcrowded rooms, &c., so that no permanent mischief is established. Poisoned air plays a part in the production of scrofula, anæmia, and lowered conditions generally; but it is an incomplete comprehension of the causes of these conditions to set down all to this one. The air, also, may be poisoned by other gases, such as carburetted hydrogen.

The atmosphere is modified by currents—sometimes to the relief, sometimes to the danger of mankind. Winds can remove sources of contagion—they can 'clear the air.' But they can also bring contagion into localities according to many authorities. Cholera and other diseases have, it is said, followed aerial currents—that is, have been carried by them. East winds are a prolific cause of disease; they excite it directly, and carry off healthy individuals, even though the cold be not extreme. Sometimes westerly winds have a dangerous influence, and in the winter of 1877–1878 a wave of disease, having many of the characteristics of 'influenza' was carried across England by a west wind.

11. **Previous Disease.**—Previous disease often predisposes to the same or to some other affection, and no clinical history is of value unless it includes an account of former illnesses. In difficult and doubtful cases a true statement of these often gives the clue to diagnosis, and even patients themselves are alive to the value set upon an accurate account of their life-ailments. An attack of croupous pneumonia predisposes to recurrence, especially during the twelve months succeeding the attack; and it may leave behind a predisposition extending far beyond the original disease. Chorea, acute rheumatism, tonsillitis, and epilepsy tend to recur, as also do the ordinary convulsions of children; but in all these and many other cases it is difficult to estimate the exact part played by derived predisposition, because in all the primary predisposition may be the main agent in the subsequent attacks. In practical medicine it is distinctly recognised that certain diseases predispose to disease, and in their case recurrence is, very properly, jealously guarded against. Pertussis is supposed to predispose to measles, and *vice versâ*. There is distinctly a connection between chorea, rheumatism, and scarlet fever, and these diseases may follow one another in any order. Again, previous disease may leave behind pathological lesions which remain in abeyance until excited by causes which the healthy individual could readily withstand. Pertussis often ends to all appearances favourably, but afterwards the patients may suffer from severe lung-affections, upon trifling exposure to exciting influences. Calcareous deposits in the lungs may excite a new catarrhal phthisis; hepatic mischief followed by collection of gall-stones in the gall-bladder may cause peritonitis and other diseases. Slight complaints are even more marked in their predisposing powers than serious diseases. On the other hand, previous disease sometimes protects individuals and communities; for example, vaccination can save nations from the most terrible of scourges. In the case of scarlet fever, typhus, pertussis, measles, &c., an almost perfect immunity is acquired by those who have already suffered from them. Of course, as with small-pox, no one denies that second attacks of these diseases do occur, but such attacks are wholly exceptional.

12. **Mental and Moral Conditions.**—Bad news may cause sudden death, or, short of this, may interfere with the functions of particular organs. Sudden mental worry may excite dangerous interference with digestion, or start an abnormal cardiac rhythm. Fright has turned the hair white within a few days or hours in healthy persons. Mental and moral shock can check or increase the flow of urine, and, in fact, can affect all the excreting and secreting organs of the economy. Mental overwork can excite, *per se*, brain-conditions of a dangerous nature, such as hyperæmia or anæmia, and even, it is said, meningitis of simple or tubercular form, according to the inherited predisposition. Undue or sudden emotional disturbances can excite serious mischief, just as they can predispose to it. Again, the mind is affected by imitative influences; thus chorea is excited in some individuals by watching choreic movements, and a single hysterical patient may arouse in others symptoms almost identical with her own. The subject of the direct influence of the mental and moral state on disease is, however, too wide to be here dwelt upon.

13. **External Physical Conditions.**—These are very numerous as exciting causes of disease. Violent over-exertion can cause herniæ, hæmorrhages, as from the vessels of the lungs, cerebral congestions, and even ruptures of the valves of the heart, and in one or all of these cases lead directly to death. Over-exertion with the voice may be followed by pharyngitis or laryngitis. Syncope has occurred in the most healthy from violent exertion in hill-climbing, in boat-racing, walking and running matches, &c., acute dilatation of the ventricles probably occurring. Various forms of direct injury are frequent causes of disease.

14. **Poisons.**—Poisonous gases are powerful excitants of disease, and so are poisons generally, whether animal, vegetable, or inorganic. They

may kill quickly or excite a disease of long-continued or even permanent nature.

15. **Temperature.**—Heat and cold carried to excess may prove fatal at once. The influences of severe cold are described under the heading COLD, and it is only with the diseases excited by heat and cold in the everyday acceptation of these terms that we shall deal here. Long-continued heat lowers the vital powers, and may excite such diseases as slight eczema of a simple character, or such grave affections as inflammation of the membranes of the brain. Heat may kill suddenly, as in sun-stroke, or excite cerebral mischief just short of death; while in persons of tubercular diathesis it may induce tubercular meningitis; and even more general effects follow severe local applications of heat. Moderate heat applied to the back often depresses the heart even to syncope. Choleraic attacks in this country usually are associated with exposure to immoderate heat.

Cold is the most common cause of disease in temperate climates, especially in the changeable climate of this country. It can excite disease directly, and can affect probably all the organs of the body, causing either disturbed function or organic mischief. Cold, when severe, contracts the vessels; interferes with the circulation, and all vital activity; and in this way may cause death. But it is with moderate degrees of cold we have chiefly to deal. A momentary exposure to a cold draught is as frequent an excitant of disease as general exposure for a long time. A cold draught playing on the cheek may cause facial paralysis, sore throat, or bronchitis; that is to say, cold applied locally may excite disease in the neighbourhood of its application or in distant organs. It is probable, therefore, that cold may act in several ways: (1) it may interfere with circulation; (2) it may affect the extremities of nerves and excite disease by reflex action; or (3) it may check secretions of the skin, the mucous membranes, &c.

We cannot wonder, therefore, that diseases of the throat, larynx, and lungs are frequently excited by cold. Bronchitis and pneumonia are its most common results; and as the young and the old are less enduring of cold than adults, it carries them off with great frequency. Diarrhœa, renal diseases, congestion of the liver, acute and chronic rheumatism, simple dyspepsia, and a host of other affections, are traceable in many instances to cold. Predisposition has much to do with the effects of cold; some individuals suffer from one form of disease when exposed to it, others from entirely different affections. In some, 'a common cold' is most evidenced by severe muscular pains and fever, in others by a nasal discharge, in others by headache, and so on. Some persons never suffer from 'cold' without having an attack of herpes labialis; and numerous similar idiosyncrasies might be given. The effects of cold should always be considered with almost all predisposing causes of disease. 'Cold' is a vague term and not thoroughly understood; there is all the more reason why, when it comes under consideration in individual cases, its precise effects should be most carefully considered and recorded.

16. **Diet.** — Food and drink can by their abuse excite disease, and gluttony is as powerful an excitant as drunkenness, though in temperance outcries this fact is almost completely lost sight of. Excess of food does not refer simply to the quantity taken, but to its quality—its nature, richness, and the times when it is taken. Agricultural labourers eat more than the gentry, but live longer, and the gentry of old-fashioned type are longer-lived than those who frequent the fashionable world. Excess of food overloads the stomach, makes calls upon it which it cannot meet, and dyspepsia is the result. Excess of food, if digested, charges the blood with materials not demanded by the economy, and disease of excretory organs or fatty degenerations may thus be excited. Want of food also excites disease, such as pneumonia, bronchitis, or other catarrh, especially in children, many deaths amongst whom are the direct consequence of improper feeding. When the proper admixture of the elements of food is neglected, disease results, as, *e.g.*, scurvy. Particular foods will immediately excite violent gastric catarrhs in some individuals, while others can bear them perfectly well. Putrid food is an active poison. Certain kinds of fish are poisonous in themselves, and some vegetable foods laden with salts of lime are supposed to cause urinary calculi. Water and milk are prolific sources of mischief, through the impurities they so often contain. The drinking waters of large towns are usually derived from rivers, and filtration is not a sufficient purification, so that disease may be excited by their use. Alcohol is a most extensive source of disease: it causes, when taken in excess, cerebral, gastric, intestinal, hepatic, and renal affections, and can lower the system so far as to predispose to other diseases. *See* ALCOHOLISM; and POISONOUS FOOD.

17. **Epidemic Diseases, Contagion, Malaria, Parasites,** and **Growths** are treated of under separate headings. It is now generally established that the diseases known as the acute specific diseases are mostly direct consequences of some contagium. So among the most common exciting causes of disease we must class the contagia of the several fevers, of syphilis, &c. *See* PERSONAL HEALTH; and PUBLIC HEALTH.

J. PEARSON IRVINE.

DISEASE, Classification of. — Various classifications of diseases, or systems of nosology, have been adopted by different writers, but it is beyond the province of this work to discuss these arrangements, neither of which fulfils all that is required, or can be regarded as satisfactory. All that can be done here is to point out the characters upon which the chief divisions of diseases are founded.

The first classification deserving of mention is that into (1) **General** and (2) **Local.** **General** diseases include those in which the whole system is involved from the commencement, and it comprehends as sub-divisions (*a*) The *acute specific fevers*, and certain other diseases due to the introduction of some morbific agent into the body from without, or in some instances developed within the system, for example, typhus and typhoid fevers, scarlatina, small-pox, malarial fevers, hydrophobia, syphilis

pyæmia and septicæmia. (*b*) The so-called *constitutional*, *cachectic*, *diathetic*, or *blood-diseases*, some of which seem to depend upon the production of deleterious elements within the system, which are capable of recognition, such as rheumatism and gout; while others are independent of any such obvious pathological causes, but are supposed to be severally associated with a peculiar dyscrasia or diathesis, for instance, cancer, tuberculosis, scurvy, rickets. **Local** diseases are those which primarily affect particular organs or tissues, each being liable to its own peculiar lesions. Thus we have diseases of the lungs, heart, stomach, liver, kidneys, brain, and the other organs; of the mucous membranes, serous or fibro-serous membranes, skin, periosteum, bone, and other structures. This division into general and local diseases is useful within proper limits, but it must be remembered that general maladies are often revealed or accompanied by local lesions, and that complaints which are originally local often more or less speedily set up general disturbance. Moreover, it is still a question whether some maladies are to be regarded as general or local in the first instance. *See* SYMMETRY IN DISEASE.

Another division of diseases, which applies more particularly to those which are of a local nature, is into (1) **Organic** or **Structural**, and (2) **Functional**. These terms are self-explanatory, the former implying that there is some organic change in the affected part, which we can discover and demonstrate; the latter indicating that there is mere functional disorder, which is independent of any recognisable lesion. That there are structural changes in many affections which are regarded as functional is, however, highly probable, though our means of observation are not sufficiently powerful to enable us to detect them. In connection with each organ, a special classification of its individual complaints under one or other of these primary headings is usually adopted, this sub-division depending upon the affections to which the particular organ is liable. As illustrations of functional disorders may be mentioned disturbed action of certain organs, as of the heart, causing palpitation; derangement of the secretory or excretory functions, as in the case of the stomach, liver, or kidneys; and many nervous disorders. Organic diseases are exemplified by inflammation and its consequences; alterations in growth and development; degenerations; malformations; and new growths. In this work it has not been deemed advisable to describe the diseases of the several organs according to any definite scientific arrangement, but in some cases an alphabetical order has been adopted, while in others individual writers have been allowed to classify the affections of a particular organ according to their own judgment.

Again, diseases may be classified according to their causation and mode of origin. Thus they are divided into (1) **Hereditary**, or those which are transmitted either directly from parents to children, or indirectly, as the result of a family taint; and (2) **Acquired**, or those which are developed anew in persons free from hereditary taint. When a morbid condition exists at birth, it is said to be **Congenital**. Other divisions, founded on an ætiological basis, are into (1) **Contagious** or **Infectious**, and (2) **Non-contagious**; and into (1) **Specific**, or those diseases which are due to a specific cause, and (2) **Non-specific**.

There are other classifications of diseases, which need only be mentioned here. Thus, according to their intensity and duration, they are said to be (1) **Acute**; (2) **Sub-acute**; or (3) **Chronic**. Another arrangement, founded on their mode of progress, is into (1) **Continuous**; (2) **Periodical**, or affections which come on at more or less definite intervals; (3) **Paroxysmal**, or those which are characterised by sudden or acute paroxysms; and (4) **Recurrent**, or diseases which tend to recur. Lastly, according to their mode of distribution amongst communities or in districts, complaints are said to be (1) **Sporadic**; (2) **Epidemic**; (3) **Endemic**; and (4) **Pandemic**. The meanings of these terms are defined under their several headings, but they are sufficiently familiar as indicating the mode of distribution of the diseases to which they respectively belong.

With regard to the classification of diseases which is likely to be permanently adopted in the future for general use, it is probable that this will be founded on a pathological basis, and that, as our knowledge of morbid conditions and processes becomes more extensive, accurate, and definite, it may become possible to establish a system of nosology which will be both scientific and practically useful.

FREDERICK T. ROBERTS.

DISEASE, Diagnosis of (διά, intens., and γινώσκω, I know).—SYNON.: Fr. *Diagnose*; Ger. *der Diagnose*.

DEFINITION.—Diagnosis is the art of recognising the presence of disease, and of distinguishing different diseases from each other. The term is also applied to the result obtained.

GENERAL CONSIDERATIONS.—The *general principles* only of diagnosis will be here discussed. *Special diagnoses* will be treated of in connection with the several diseases to which they have reference.

In many respects diagnosis is a subject of great interest and importance. First, in a scientific point of view, it is essential that all knowledge should be accurate. Secondly, accuracy of diagnosis, founded upon a sound pathology, enables us to frame a scientific classification of disease in its diverse forms. It is also by accurate determination of the nature of the disease which may be present in any given case that we are able to anticipate its course, and to employ the right kind of remedies in its treatment. It is imperfection of diagnosis which leads in many instances to an under-estimate of the value of therapeutical agents; for when the nature of a disease is mistaken we are led to employ improper and unsuitable remedies, the failure of which is then erroneously attributed to the inefficiency of the agents, and not to the unfitness of the treatment employed. If our diagnosis had been correct or complete, the remedy selected would more often have had the desired effect.

In order to arrive at a diagnosis we must study the phenomena or characters of each in-

dividual case, and trace its connexion with those groups of symptoms which have been previously recognised and described as belonging to special or distinct diseases. Assuming that the classification has been already made, we proceed to deal with the means which enable us to identify each individual case, and to connect it with a previously classified disease.

Means of Diagnosis.—To obtain accuracy in diagnosis we must be prepared with a knowledge of the several forms and varieties of disease; we must be familiar also with the functions and structure of the several organs of the body in health. It is by observing and comparing the changes caused by disease in the these functions and structures, that we are enabled to discover the presence of, and to determine the nature of disease. In forming, then, a diagnosis in any particular case, the physician must, as far as possible, keep in view the real or the ideal condition of the patient in a state of health. He must endeavour to place him in as natural a position as may be, and as little disturbed by the presence of his attendant, or by external circumstances, as possible. The physician must then obtain a history from the patient himself or from others of the incidence of the disease; and having done this he must proceed to investigate for himself the condition of the patient.

1. *Previous history of the patient.*—The history implies of course a statement of the age and sex of the patient, as well as of his home and his employment—each of which may have a special relation to disease. It should also include an inquiry into the antecedent generations of the patient, and how far he may have any proclivity to congenital disease or malformation. This inquiry should have reference to both positive and negative facts. It should extend not only to the previous existence of disease in the family, but also to the absence of particular diseases or types of constitution. The patient's history should include a statement as regards the diseases and injuries from which he may previously have suffered; the remedies used for them; and the climatic and other influences to which he has been exposed. Nor must the physician neglect to ascertain the history of any children that the patient may have had, as the nature of disease from which the offspring have suffered in many instances throws light upon the health of the parent.

2. *History of present illness.*—The history of the present illness should include the determination of the date of its commencement; its probable cause; and its progress as influenced by external circumstances, including treatment.

3. *The present condition of the patient.*—Here we have to deal with two classes of phenomena; namely (*a*) those feelings or facts of self-consciousness which the patient describes to us—*subjective phenomena*; and (*b*) those signs which we ourselves observe—*objective phenomena.*

a. Subjective phenomena.—The patient describes to us his feelings—as of strength or weakness, of numbness, tingling or pain, of wakefulness or wandering; he can tell of affections of vision, of hearing, of smell, or of taste; of breathlessness, cough, palpitation, or of feelings of sinking or faintness; of difficulty of swallowing, thirst, loss of appetite, nausea or sickness, or various sensations and actions connected with the abdomen; of feelings associated with the genito-urinary organs, such as pain or difficulty in passing water; of cramps, spasms, or other alterations of sensation or motility; or of disturbances of sensibility and activity, &c. Each of these signs of deviation from health will have its own value and significance. The physician must at the same time carefully note how far the condition of the patient is in accordance with his statements, and whether there may not be present some reason or cause for concealment or exaggeration.

b. Objective phenomena. In studying the objective phenomena connected with disease, the physician makes use of his special senses, assisted by the several instruments with which modern science has provided him.

First, in matters of *eye-sight*, he sees the general aspect and expression of the patient, which will include the colour of the skin (such as may result from the fulness or emptiness of the blood-vessels, from the yellowness caused by jaundice, from the blueness of cyanosis, or from pigmentation, &c.); the presence and character of cutaneous eruptions (especially in the exanthemata); the expression proper, such as that of ease or suffering, and of depression or excitement; the conditions of obesity and plethora, or of wasting and bloodlessness. He will also observe the position of the patient, how he lies, or sits, or stands, and how breathes; the appearance of the eyes, the tongue, etc. Further, the sense of sight will be employed in determining conditions of a local or less general nature. Observation must be made of the size, the shape, and movements of parts, and of their expansion or contraction. With the aid of special instruments, such as the ophthalmoscope, the laryngoscope, the various specula, sounds, &c., the physician will be able to examine parts of the body of the patient, beyond the reach of the unassisted eye. The chest-measurer or the stethometer will render more exact the information already obtained by the eye and hand as to the size and mobility of parts. The use of each of the several instruments above mentioned, as a means of diagnosis, will be found described under the heads of their respective names, or in the article on Physical Examination.

The sense of *hearing* tells of the character of the breathing, the voice, and speech of the patient, including cough, hoarseness or aphonia, 'aphasia,' &c. But the ear is especially applied to the study by auscultation of the sounds produced in connexion with the heart, the lungs, and other organs. The signs thus elicited will be found fully described elsewhere.

The sense of *touch* or feeling will communicate a knowledge of the temperature, of moisture or dryness, of size, shape, elevation or depression, of smoothness or roughness, of the pulse or pulsation, vibration, fremitus, of extent of movement, resistance, softness or hardness, and of fluctuation. The accuracy of the results of these observations by touch may be tested by the use of the thermometer, the calipers, and the tape-measure.

The sense of *smell* aids diagnosis in certain cases. The general odour of the patient may

be observed in small-pox, in rheumatism, and some wasting diseases (such as phthisis), and in syphilis; and the odour of particular parts and secretions, as the urine in diabetes, and in cases of the use of certain drugs, or in poisoning. Information is also afforded by the odour of certain discharges, as in ozæna, leucorrhœa, cancer, &c.

The sense of *taste* is seldom employed in clinical investigation, but the physician may make use of the patient's taste, as in tasting the urine in diabetes.

Further aids in Diagnosis.—Having thus summarily described the employment of the special senses in diagnosis and given examples of their use, we may briefly mention some other agencies of more general application. The acuteness of the patient's sense of touch may be determined by the æsthesiometer; the capacity of the lungs may be measured by the spirometer, and the strength of muscles by the dynamometer; the contractility of muscles by galvanism; the force and character of the pulse are determined by the sphygmograph; constant use is found for the microscope, the test-tube, the spectroscope, and polariscope, which aid in determining the character of the various secretions or morbid matters that require to be submitted to investigation. The result of treatment may also be mentioned as an aid to diagnosis, as for example, when an indurated sore yields to the use of mercury. Again, the knowledge that a person has been in a malarious district enables us to decide on the intermittent nature of certain symptoms that may be present. In some cases it may be necessary to render a patient insensible by anæsthetics, with a view to making a complete examination, or in investigating feigned diseases. The administration of small doses of charcoal has been suggested as a means of determining the presence of a passage through the bowels when more or less obstruction exists.

Such then are the means used for taking note of those deviations from health which occur in the several functions and structures of the body, and which constitute what are known as the *Symptoms and Signs of Disease*; these are terms which will be found more specially treated of under the heads Disease, Symptoms and Signs of; and Physical Examination.

The Difficulties of Diagnosis.—It needs scarcely be said here that the practice of diagnosis is not free from great difficulties. We know how hard it is to obtain in ordinary daily life a reliable account or description of any past or present event. There must be still greater difficulty in obtaining an accurate medical history of a patient's case. He has to tell of facts of which practically he may know much, but scientifically very little. He may be forgetful or ignorant on points about which we most need to be informed. He may be inclined to exaggerate or to suppress facts of material import. Nor are the difficulties less in regard to the *objective phenomena* with which we have to deal. The symptoms of a disease are rarely so clear and definite as to mark its nature, that is, to be *pathognomonic*. They are more often slight, undefined, obscure, and to be found with difficulty. The symptoms of one disease may very closely resemble those of another, whilst those of the same disease will vary at different stages, and in different individuals. Again, the symptoms of a disease may be complicated by the co-existence of those of another disease; whilst a symptom sufficiently striking in itself may be common to, and present in several different diseases. We need only mention, for example feverishness, pain, cough, breathlessness, and blood-spitting.

These are some of the difficulties which he who has to study the operation of disease in life, has to contend with. He must come prepared for the duty with a knowledge, as we have already said, of the body, its structure and functions in health, and with a knowledge too of those combinations of morbid actions which constitute special forms of disease. For as regards this latter knowledge, all the observations made would remain as isolated phenomena if they could not in each case be grouped as constituting distinct diseases.

We have thus indicated the difficulties of obtaining accurate knowledge as regards both the subjective and objective phenomena. The difficulties are not less when the exercise of the intellectual and reasoning faculties is called upon to analyse, to compare, and to group these phenomena.

The physician may commence his inquiry by tracing up the history of the case and its several incidents, a method which is called the *synthetical*; or he may commence by ascertaining the present condition of the patient, and going as it were backwards in his inquiry—a method which is known as the *analytical*. As a general rule, both methods are combined in the practice of diagnosis.

Observers can sometimes arrive at a *direct diagnosis*, aided by the presence of some characteristic symptom or sign of disease. When diseases which are essentially different have symptoms more or less common to both, the physician will have to institute a *comparison* between them, until he finds sufficient evidence, in the presence or in the absence of some distinctive symptom or sign, to satisfy him as to the nature of the disease which is present. By being able thus to trace the absence or the presence of a given symptom, he may be able to *exclude* the possibility of the existence of one or other of the diseases under investigation. These modes of investigation will be found fully illustrated in the diagnosis of the several diseases described throughout the work.

In conclusion, it must be remembered that these investigations, which call for the exercise of the highest mental faculties, should be conducted without prejudice and without haste. We should never be ready to accept as clear that which is obscure, as established that which is open to question: above all we should remember that, though to err is human, it is our duty to endeavour to ascertain in each and every case, before commencing its treatment, what its real nature is, as far as it may be possible for us to do so. It cannot be too often repeated that the application of a right remedy depends on an accurate diagnosis, and that the prevention and the cure of disease are the aims and ultimate objects of our science. R. Quain. M.D.

DISEASE, Duration of.—The duration of a disease signifies the period which elapses between its onset and its termination, in whatever way this may take place. In some instances disease can hardly be said to have any duration, a sudden lesion occurring, which instantaneously, or in a very short time, destroys life; under such circumstances, however, some previous disease has usually existed, though perhaps without giving any clinical evidence of its presence, which determines the occurrence of the sudden result. This may be illustrated by some cases of apoplexy, and of rupture of the heart or of an aneurism. Most affections, as regards their duration, come under one of the three categories already referred to under the classification of diseases, namely, *acute*, *sub-acute*, or *chronic*, but it does not serve any useful purpose to fix any definite limit of time as specially expressed by each of these terms. *See* Acute, and Chronic.

Acute diseases are of limited duration, and in many of them this is remarkably uniform, as may be illustrated by the acute specific fevers and acute idiopathic pneumonia. Even in such affections, however, there are deviations from the ordinary course, instances occurring in which the duration is longer or shorter than that usually observed, and this fact depends on various circumstances, of which the most obvious are the intensity of the disease in any particular case, the previous condition and surrounding circumstances of the patient, the occurrence of complications, and the treatment adopted. Complaints which are *sub-acute* as regards their duration may be exemplified by many cases of whooping-cough and chorea, and by some cases of pleurisy, phthisis, pneumonia, gastric or enteric catarrh, and certain skin-affections. A large number of diseases are *chronic* in their duration, and many of these when once established become permanent, whilst others are ultimately capable of being cured. As illustrations may be mentioned organic diseases of the heart, most cases of phthisis, cirrhosis of the liver, chronic Bright's disease, dyspepsia, many skin-affections, and also morbid growths in various structures.

Some complaints, as regards their duration, can only belong to one or other of the groups just indicated, but a considerable proportion may in different cases be either acute, sub-acute, or chronic. Again it must be borne in mind that a disease may be acute or even sudden in its origin, but afterwards may subside into a chronic malady. Certain affections are chronic as regards their entire duration, but are characterised by the occurrence at regular or irregular intervals of acute or even sudden attacks, lasting a more or less definite time, which course of events is exemplified by cases of ague, epilepsy, and asthma.

Frederick T. Roberts.

DISEASE, Germs of. — *See* Germs of Disease.

DISEASE, Prognosis of (πρὸ, before, and γινώσκω, I know).—Syn.: Fr. *Pronostic*; Ger. *Prognose*.

Definition.—Prognosis is the art of forecasting the progress and termination of any given case of disease. The term is also applied to the foreknowledge thus obtained.

General Considerations.—It is a matter of interest and often of great importance to be able to indicate with precision how a case of disease or injury will be likely to advance and terminate. This question must be always present to the physician's mind; and it can rarely be absent from that of the patient and of those who are interested in his well-being. It can easily be seen how much depends upon the answer of the physician to the questions constantly proposed to him, How long is this illness likely to last? How is it likely to terminate? If in recovery, will the recovery be complete or partial? If in death, when and how?

Grounds of Prognosis.—The knowledge which can give trustworthy answers to such questions as the preceding must be founded upon an accurate diagnosis of the nature of the disease from which the individual is suffering; upon the capability of remedies to control it; and, lastly, upon an estimate of the constitutional and vital powers of the patient.

First, as regards the *nature of the disease*. Some diseases which are mild in their nature run a definite course and end favourably; take, for example, a simple catarrh. Others commence with great intensity, and come to a favourable or unfavourable termination very rapidly, for instance, Asiatic cholera, of which many of the subjects die in less than twenty-four hours from the time of their first becoming manifestly ill. A third group, such as typhus, typhoid fever, and certain of the exanthemata, run a longer and more defined course, seldom terminating in death except after the lapse of many days, nor in recovery except after a period of some weeks. Another class of maladies, chronic in character, rarely acute, such as we see in tubercular diseases of the lungs, render the patient more or less an invalid so long as he lives, and generally end fatally. The like observation will apply to the so-called malignant diseases.

Secondly, the *intensity of the particular attack* affords further grounds for prognosticating the result. Thus in a fever, great prostration, high temperature, and rapid pulse, indicative of the severity of the disease, must lead to the formation of an unfavourable prognosis; just as great debility and wasting, with disturbance of the nutritive functions generally, would indicate a like result in chronic diseases.

Thirdly, in regard of local diseases or complications, whatever the nature of the disease may be, the *organ affected* must form an important element in prognosis. Thus disease of the brain, or of the heart, or of the lungs, or, in a lesser degree, of other viscera, must, even when not specially severe, be looked upon as affording grounds for anxiety, from a prognostic point of view.

Fourthly, as regards the *constitution, age, and sex of the patient*, it may be safely anticipated that in a patient with a good constitution the prognosis will be more favourable than in a person with a feeble or broken-down constitution. Persons whose vital powers are unimpaired will resist disease, and recover under circumstances which would be fatal to other individuals, in

whom, on the one hand, plethoric habits may predispose to acute and rapid changes, or who, on the other hand, by degeneration of tissues may be rendered liable to succumb, and that rapidly, to morbid influences which healthier textures could resist and overcome.

Disease is badly borne by the very young and the very old. In very young children disease rapidly runs its course, favourably or unfavourably. The aged have little power of reaction or of resistance; and disease in them, though less pronounced, more frequently ends unfavourably. In middle life, disease may be expected to assume an acute or sthenic form.

As a rule, sex has little influence on the prognosis of disease, except that usually diseases of equal severity are more amenable to treatment in females than in males. Nervous symptoms are however more easily developed in women, exaggerating a condition that might not otherwise be unfavourable. Menstruation, pregnancy, parturition, and lactation have all a certain amount of influence, sometimes favourable and sometimes the reverse, on disease in the female.

Fifthly, with respect to *treatment*; a more or less favourable prognosis may be founded upon the fact that the patient can enjoy all the advantages afforded by rest, diet, change of climate, &c., which may not be available under other circumstances for like cases. It is well known that there are some remedies which have a specific effect upon certain diseases, as quinine upon intermittent fever; mercury in some forms of syphilis; iodide of potassium in certain stages of the same disease; and colchicum in gout. In such cases a much more favourable prognosis can, of course, be given than in those for which no such remedies are known to exist. Experience tells us that favourable results follow in many other cases in which suitable though not actually specific remedies can be applied.

Taking into consideration, then, the above conditions—the nature, the intensity, and the seat of the disease; the constitution, the resisting-power, the age, and the sex of the patient; and the possibility of applying suitable and efficient remedies—we are able, in a large number of cases, to arrive at an accurate conclusion as to what the course and result of a disease will be.

Difficulties of Prognosis.—Still, to arrive at an accurate prognosis is often very difficult. Disease is not always identical in its character, nor definite in its progress or results. The constitutions of individuals vary, and it is often very difficult to measure their powers of resistance. Remedies, too, vary in their action and their operation; and sometimes we are deceived in the best-founded conclusion as to the results that they will accomplish. There are few physicians who cannot recount the errors of prognosis made by themselves or by their colleagues. Many persons now live who had been doomed to die; and many persons have died whose death was not anticipated. It is the duty of the physician, when asked for his opinion, to state it honestly, but with great discretion, and in general with as much hope as is fairly admissible. He must be guarded as to the manner in which his view is communicated to the patient, for there are many individuals whose temperament is such that the progress of their disease would be greatly influenced for good or for evil by the expression of a favourable or of an unfavourable opinion. At the same time, the physician must avoid deceit; and if there be risk or danger in communicating an unfavourable prognosis to the patient, he must at least communicate it to some judicious individual amongst the patient's friends. Altogether too much caution cannot be exercised in stating, in any obscure case, what its progress and result will be. There are many cases in which the medical attendant will be justified in replying that he is a physician, and not a prophet. He cannot always foretell results, his aim and object ever being to mitigate the patient's suffering, to prolong life, and to cure the disease if possible: full often to profess or to do more than this is beyond his art.

R. Quain, M.D.

DISEASE, Symptoms and Signs of.—When disease affects any of the functions or structures of the body, it produces certain altered actions or changes, which, when observed during life, become evidences of its presence and often of its nature, and which then are called the symptoms and signs of disease.

The terms *symptom* and *sign* are often used synonymously, though the derivations of the words are by no means the same. *Symptom*, according to its derivation (*σύμπτωμα* = a coincidence) means simply a *coincidence*, that is to say, it coincides with the presence of certain phenomena. The term *sign* (from *signum*) is more distinctive, and seems more directly to point to some special or peculiar condition. Recently, however, an attempt has been made to give a more special meaning to these terms. Symptom, more especially if it be characterised by the prefix *vital*, is intended to refer to modifications of functions, or to such *subjective* phenomena as we can learn from the patient's account of his feelings. On the other hand, the term *sign*, more markedly with the prefix *physical*, indicates those morbid changes which are *objective* or may be recognised by the senses of the physician, assisted by other appliances.

It would possibly be well if the meanings of the words—symptoms and signs of disease—as above stated, were to come into general use; but there are many difficulties in the way. For example, if the ear be applied to the chest in the case of incompetence of the aortic valves, we hear a murmur, and we say that there are 'physical signs' of aortic valve imperfection; but the locomotive pulse and its peculiar beat, would by many be called a 'symptom' of incompetence of the aortic valves. It is therefore extremely difficult to draw the distinction between the terms symptom and sign.

By whatever name these phenomena may be called, we must rely upon them as the means by which we are enabled to form our diagnosis. The more accurate and complete our knowledge of the functions of the body and of its component parts, and the more capable we are of interpreting, with all the completeness possible, the changes produced by disease, the more accurate will be our diagnosis as to its presence and its nature. How these phenomena may be best observed will be found discussed under the articles on Disease, Diagnosis of, and Physical Examination.

R. Quain, M.D.

DISEASE, Terminations of.—The terminations of a disease must be regarded both from a *pathological* and from a *clinical* point of view. Each pathological process or condition has modes of ending peculiar to itself, but it is beyond the province of this article to discuss these at any length, and one or two illustrations must suffice. Thus, inflammation may terminate by resolution; by the formation of different effusions or exudations; or by causing suppuration, softening, induration, ulceration, or gangrene. Fever, if it end favourably, may terminate by crisis, lysis, or a combination of these modes, or in an irregular fashion. An effusion of blood may remain more or less altered; may undergo organization; may soften and undergo a puriform change; may form a cyst; or may be altogether absorbed.

The *clinical* terminations of diseases are highly important, and demand more consideration. In the first place, a disease frequently terminates in the *death* of the patient. This event may take place suddenly or very rapidly, from the occurrence of some serious lesion, or of grave functional disorder of an organ essential for carrying on the phenomena which constitute life. In other cases death is the termination of a more or less acute illness, either affecting a person previously in the enjoyment of good health; or, what is not uncommon, being the consummation of a chronic malady, which has existed for a longer or shorter period. In still other instances, death is a slow and chronic process, the patient gradually sinking, several causes and morbid conditions often ultimately contributing to the fatal event. The modes in which death occurs are described elsewhere, and therefore need not be discussed in this article. *See* DEATH, Modes of.

In the next place, a large proportion of cases of disease end in *complete* and *entire recovery*, the patients being restored to their previous state of health, and no organic mischief established. This result may be expected in most of the ailments or functional disorders which are of such common occurrence, provided proper treatment is carried out. Again, the great majority of cases of acute disease terminate in complete recovery, taking them in the mass, though several affections of this class, when they do not prove fatal, are liable to leave behind them more or less serious deterioration of the general health, or even actual organic disease. In this class of cases, when recovery does ensue, it is usually only after a more or less prolonged period of convalescence. Chronic complaints, if they are of a structural nature, cannot in most instances end in complete recovery, although to all appearance the patient may often be quite restored. Even in these cases, however, an actual cure may sometimes be effected, and that after a disease has had a prolonged duration. This is illustrated by several chronic skin-affections, syphilis, and chronic inflammation of mucous surfaces. Or it may happen that the patient recovers perfectly, only with the destruction of some structure which is not essential to life, such as the lymphatic glands.

Thirdly, *partial* or *incomplete recovery* is a very common mode of termination. This is observed in many cases of acute disease, where either the patient remains permanently in a state of general ill-health, without any actual structural lesion being discoverable; or some positive organic affection has been established of which phthisis remaining after acute pneumonia, or cardiac disease following acute rheumatism, afford apt illustrations. An attack of an acute malady may also serve to bring out some latent constitutional predisposition; or may leave the patient in such a condition that certain so-called constitutional maladies are readily originated from slight causes. Partial recovery, amounting often to very marked improvement, may take place in many serious diseases of a chronic nature. This is illustrated by numerous cases of pulmonary consumption, in which disease great improvement is often observed, not only as regards the symptoms, but also in the local lesions, so much so that patients not uncommonly regard themselves as cured. Again there are some complaints in which apparent recovery is brought about, but a tendency to recurrence remains, either without any obvious reason or from slight causes. Such affections are exemplified by ague, asthma, neuralgia, intestinal catarrh, bronchitis, and certain skin-diseases. As instances of incomplete recovery may be also mentioned the cure of some prominent symptom or symptoms, while the disease which originates these phenomena continues unaltered. Thus, it may be possible to get rid of ascites, which the patient regards as the disease from which he suffers, while cirrhosis of the liver, upon which the ascites depends, is a permanent condition; extensive dropsy and other symptoms associated with cardiac diseases may also be got rid of, while the organic mischief still remains. Sudden lesions may terminate in partial recovery. For instance, a case in which a sudden hæmorrhage into the brain has occurred, attended with marked apoplectic and paralytic symptoms, not uncommonly improves remarkably in course of time, the clot being more or less absorbed. Some complaints, which are usually sudden in their onset, may apparently be recovered from completely, but sometimes set up conditions which ultimately lead to permanent disease. Thus the passage of a gall-stone or of a renal calculus may excite such irritation as to cause an inflammatory process to be set up, which may induce permanent mischief, such as closure of the bile-duct or of the ureter in the several instances, and the effects may not be perceptible until a considerable interval has elapsed.

Lastly, it must be remarked that some affections can hardly be said to have any termination. They continue during the life of the individual, perhaps interfering but little or not at all with the health, or at all events not in any way contributing to the death of the patient, when that event does happen. This applies to many of the ailments from which people suffer; as well as to many chronic organic diseases not in themselves serious or giving rise to any important symptoms, and not implicating structures essential to life. FREDERICK T. ROBERTS.

DISEASE, Treatment of.—This term has reference to the means by which disease may be

prevented—*prophylactic* or *preventive* treatment; or its effects counteracted when it occurs—*remedial* or *curative* treatment.

1. **Preventive treatment** will be found discussed under the heads—CONTAGION; CLIMATE; DISEASE, Causes of; DISINFECTION; MALARIA; PERSONAL HEALTH; PUBLIC HEALTH, &c.; as well as in the several articles treating of special diseases. It is therefore unnecessary to say more upon the subject in this place.

2. **Curative treatment.**—Bearing in mind that disease is a deviation from health in the functions or component materials of the body, it must be remembered that there is in organized bodies a tendency to maintain their healthy function and structure, and in case of disease or injury to recur to it. This is especially manifest in the lower types of animals, which when mutilated are capable of resuming more or less completely their original form, to the extent even of the restoration of parts that have been lost. In man and the higher animals this power of complete restoration is confined to the elementary cells and least complex structures of which the body consists; the more complex tissues are not reproduced, nor are lost parts restored. There is, however, in man, as in all organised beings, a tendency to rectify deviations from health, and to restore the organization to its normal condition. To remove or subdue the causes of disease, and to aid this restorative power in the establishment of healthy function and structure, is for the cure of disease the most philosophical indication that can be adopted. But our knowledge of disease and of remedial agents is not sufficient to enable us always to carry out these principles. As the treatment of disease has been directed sometimes to the one object and sometimes to the other, frequently to neither, it has given origin to a great variety of systems or methods of practice. Thus in the earliest history of the healing art, means the most diverse were used for the relief of suffering. Sometimes the suffering or the disease yielded whilst these means were being employed; and it was concluded, on very insufficient grounds, that these agents had 'cured' the disease. Persons who had felt, as they supposed, the beneficial effects of these particular remedies, communicated them to others as the result of their experience; and thus was established what has been known in Medicine as

Empiricism.—This mode of practice has its advantages and its disadvantages. When aided by accurate knowledge and discrimination it often leads to satisfactory results; and many remedies suggested by experience, and that alone, are now found to be in accord with our more advanced scientific knowledge; take, for example, the use of mercury in syphilis, which though long used empirically, is now known to act by its control over the nutrition of young cellular growths. So also with respect to quinine and other remedies of now established usefulness. On the other hand, mere empiricism, when vaguely applied, taints and damages to this day the treatment of disease. It is this practice which, for example, suggests opium to quiet a cough or a colic, without reference to the cause of the one or the other, and when an expectorant or a purgative would have been the suitable remedy; and it is this empiricism which does such harm in the hands of amateur practitioners, leading them to recommend for the relief of symptoms remedies which they supposed had relieved like symptoms in other cases, however different the real nature or causes of these symptoms may have been.

Rational Treatment. — On the other hand, modern science endeavours to take cognizance of the nature of disease, and also of the specific action of remedies; it seeks to counteract the operation of the one by the influence of the other. This constitutes the rational treatment of disease. To extend this system should be the object of the scientific practitioner. On the one side, it is his duty to study the nature of disease itself, its causes, and their effects; on the other, to study the action of various agents on the living body in health and in disease; and if possible to trace how far the one is capable of combating and subduing the other. This study of scientific therapeutics is of comparatively recent date, and is now pursued with great zeal. The results already arrived at are alike satisfactory and encouraging. As rational treatment becomes more firmly established, scientific medicine will take a more elevated and nobler position. The modes or methods by which the two great principles just alluded to, the foundations as they are of the healing art, have been applied are extremely various, and, although these different methods may be traced to the one or to the other, they have received distinctive names, according as they are marked by some special characteristic. A few of these modes of treatment may be briefly enumerated.

1. *Expectant treatment.*—This mode of treatment is founded on the principle that the restorative power should be allowed entire freedom of action, the practitioner neither assisting nor interfering with its operation.

2. What is called *Homœopathic treatment* would by some persons be included under the preceding head. It proposes to treat disease by giving in infinitesimal doses substances that are supposed to be capable of producing a diseased condition like that which they are intended to cure. It may be described in the words of Molière, who wrote long before Hahnemann, the inventor of homœopathy, as *l'art d'amuser le malade pendant que la nature guerit.* There is no doubt that in this and in similar methods of treatment, the imagination plays an active and useful part.

3. *Palliative treatment* consists simply in the adoption of means which are calculated to soothe, and to lessen suffering, and thereby to prolong life when the cure of disease is not possible.

4. *Stimulant treatment* is founded on a doctrine which regards most forms of disease as associated with or dependent on a lowered state of the vital powers, and which teaches that in such cases the free use of stimulants is the practice most to be relied on. *See* STIMULANTS.

5. *Antiphlogistic treatment* is the converse of the preceding. It recognises in many forms of disease increased nervous excitement and vascular fulness, which are to be remedied by depressing agencies, such as low diet, bleeding, purgation, &c. *See* BLOOD, Abstraction of, and DEPLETION.

6. *Purgative, diaphoretic,* or otherwise *eliminative* treatment aims at removing by the

intestinal mucous membrane, by the skin, or by the secreting glands respectively, certain morbid matters; and thus allowing the restorative power of the system to operate more efficiently. *See* PURGATIVES, &c.

7. The *Water cure*, including baths, acts partly on the principle of elimination, partly by exerting a tonic influence. *See* BATHS and HYDROPATHY.

8. *Revulsive treatment* acts by producing counter-irritation by means of blisters, setons, issues, and the like. *See* COUNTER-IRRITANTS, REVULSIVES, &c.

9. *Dietetic treatment* constitutes a greater or less portion of all modes of treatment. It implies a reference to the kind of food which is adapted to the circumstances in which the patient is placed, and which is suitable in the form of disease from which he is suffering. *See* DIET.

10. The treatment by *Climate* operates more or less by removing the patient beyond the region of noxious influences, and placing him in circumstances which promote healthy action of the several functions.

It is well known that under these several and varied modes of treatment disease may yield and patients may get well. Hence it has been said that as different means are made use of to obtain a single result, the treatment of disease can never be absolutely scientific. Phthisis is pointed out, for example, as a disease which one person seeks to relieve by cod-liver oil, another by climate, a third by tonics, a fourth by sedatives, a fifth by attention to the digestive organs, and a sixth by counter-irritation. We need scarcely say that the disease bearing the name of phthisis is an aggregate of phenomena or conditions, the relief of any one of which may lead to the amelioration of the others. Thus the general health might be improved by climate, and with it all the other symptoms. Cod-liver oil, with remedies calculated to improve the digestion, may lead to healthy nutrition, and thus to mitigation of all the symptoms. The like remark applies to the other agencies mentioned. The treatment of disease must not, then, be condemned as unscientific because it cannot remedy a variety of morbid states by a single agent, but would aim, on still strictly scientific principles, by different agencies to overcome disease the effects of which are manifested in different forms.

In conclusion, it may be repeated that the end and aim of the practitioner should be, if possible, firstly, to discover the cause or causes on which the disease depends, and to remove or counteract them if practicable; and, secondly, to endeavour, by every available means, to restore to health the functions of the body, and with that object to guide and assist Nature, but never to thwart her operations. R. QUAIN, M.D.

DISEASES, Types and Varieties of.—In the case of many diseases more or less distinct *varieties* are recognised, which in some instances constitute well-defined *types*. It is important to understand the precise significance of these terms in different cases.

In the first place the varieties of a particular affection may be founded upon diversities observed in its *clinical history*. Thus, according to the intensity of the symptoms and their duration, a large number of complaints are, as has already been pointed out, divided into acute, subacute, and chronic varieties. Again, many diseases, while presenting in the majority of cases a certain group of symptoms, upon which their general clinical description is founded, exhibit striking differences in the exact nature of the phenomena observed, as well as in their gravity, when the mass of cases is taken into account, and on these differences *varieties* or *types* are founded. This is well exemplified by some of the acute specific fevers, such as typhoid fever, scarlatina, measles, and small-pox. Of these affections several varieties are described, dependent upon the severity of the symptoms, the nature of those which are most prominent, or the characters of the eruption.

In the next place, the classification of a disease into varieties may be founded upon a *pathological* basis. For instance, pulmonary phthisis may arise from different morbid processes, and many attempts have been made to arrange the cases of this disease into corresponding groups. Illustrations of these pathological varieties are also found in the different forms of cancer; varieties of pneumonia, of laryngitis, and of fatty disease of the heart; and in the classification of serous inflammations according to their morbid products, such as fibrinous, serous, purulent, &c. Again, such a pathological condition as dropsy or fever may be divided into varieties. Thus dropsy is arranged according to its situation and distribution, as anasarca, ascites, &c.; or according to its pathological cause, whether cardiac, pulmonary, hepatic, &c. Fever is recognised as having several important types, founded upon its intensity, its course, and the exact nature of the phenomena accompanying the pyrexial state.

Another division of a disease into varieties is *ætiological*, the cases being grouped according to their causation, either the immediate pathological or the more remote exciting causes being employed as the basis of division. Thus we have the different forms of meningitis (simple, tubercular, rheumatic, &c.); the ætiological varieties of pleurisy or peritonitis (idiopathic, traumatic, perforative, tubercular, secondary, &c.); those of joint-inflammation, (simple, rheumatic, gouty, scrofulous, &c.); or those of intestinal obstruction. Ætiological varieties are often at the same time characterised by differences in the pathological results and products. Lastly, it must be mentioned that sometimes a certain *group of symptoms* is summed up for convenience under some single term, which symptoms really depend upon very different morbid conditions and causes; and therefore it often becomes necessary to classify affections thus named into varieties. Dyspepsia, neuralgia, apoplexy, epilepsy, and paralysis will afford illustrations of such an arrangement.

FREDERICK T. ROBERTS.

DISINFECTANTS. *See* DISINFECTION.

DISINFECTION.—SYNON.: Fr. *Désinfection*; Ger. *Desinficiren*.

DEFINITION.—Disinfection, in the proper sense

of the term, means any process by which the contagium of a given disease may be destroyed or be rendered inert.

Disinfectants, however, are used in practice for several objects, and in consequence the term has often been vaguely applied to the use of heat or chemical means for preventing the generation or for the destruction of noxious agents, whether products of specific disease or not. In this vague and erroneous sense disinfectants have been confounded with *deodorants*, which merely cover or destroy offensive odours without affecting the contagia; and with *antiseptics*, which 'are fatal to the growth and multiplication of microzymes.' Following the line indicated by Dr. Baxter in his valuable report on an experimental study of certain disinfectants, it is necessary to distinguish—

1. The true meaning of the word—that of acting on the specific poisons of communicable diseases in such a way as prevents their spreading.

2. That of acting upon organic substances in such a way as renders them less liable to undergo molecular change and decomposition, whether spontaneously or under the influence of catalytic agents, as in the case of emulsin upon amygdalin, or under the influence of living organisms, such as are connected with fermentation and putrefaction. Examples of this kind of action are seen in salting meat, and in preserving small animals in weak solutions of carbolic acid.

3. That of preventing or arresting decomposition by killing the torulæ associated with fermentation in slightly acid media, or the bacteroid organisms associated with putrefaction in neutral or alkaline media. Properly speaking, this is the action of an antiseptic, but the relative power of disinfectants has been largely estimated by their efficacy in this respect, partly, no doubt, because antiseptic power is desirable in a disinfectant, but chiefly because it is so difficult to submit disinfectants to their proper test by experimenting upon contagium.

4. That of the destruction of the noxious products of the metabolism of dead organic matter, however brought about. These products consist chiefly of gases or vapours, many of which, such as sulphuretted hydrogen, ammonia, and sulphide of ammonium, are easily destroyed by appropriate agents, even when used in a very dilute state, and success in this respect is no proof of the value of a disinfectant in its true sense, though the power of destroying such emanations is possessed by almost all disinfectants of practical utility.

Mode of Action.—The manner in which disinfectants are supposed to act is very various. Some, such as permanganate of potassium, ozone, and oxygen, set free from water by chlorine, oxidise organic matter. Others, such as sulphurous acid, withdraw oxygen, and have a reducing influence; or, like chlorine, may combine with hydrogen and remove it, or form substitution-compounds. Those of a fourth class, such as chloride of zinc and some other metallic salts, are supposed to owe their activity to the power which they possess of coagulating albumen or combining with it. Another class, of which carbolic acid is the type, is supposed to arrest molecular changes, whether they be those necessary for vital manifestations or for decompositions. And finally, the mineral acids are supposed to be efficacious, in part, at least, because they alter the reaction of the media containing contagia. Most disinfectants act in several of these ways.

General Remarks.—It has been proved that the contagia of several diseases must consist of minute solid particles, for they are neither soluble, nor diffusible, nor volatile, and we may infer that all other contagia are particulate likewise. A characteristic of contagium, due to its particulate nature, is that dilution lessens the chance of infection, but has little effect upon the case if the disease be taken. There is either no effect at all, or a full specific effect. Contagium particles are apt to exist as clouds in air, water, or milk, instead of being equally distributed throughout; and this bears upon practical disinfection. The particulate and non-gaseous form of contagium floating in the atmosphere prevents it from being absorbed by any liquid or solid disinfectant which does not wash or come into intimate contact with every portion of the air, and as this is impracticable, infected air can only be purified by gaseous disinfectants, such as sulphurous acid or chlorine. Disinfectants of this kind, to be effective, must be present in such a quantity as is incompatible with the existence of human beings. From this it follows that saucers of disinfecting fluids, or irritating vapours and gases in the sick-room, are merely a useless annoyance to the patient, except in so far as they may be desired as deodorants. The best method for dealing with infected air is to replace it by ventilation, especially by means of *ventilating* open fire-places. The proper use of volatile disinfectants is the purification of walls, ceilings, and inaccessible places; and for this purpose, if possible, enough should be used to saturate the atmosphere, remembering that the virulent particles are most likely protected by being buried in a bit of epithelium or surrounded by an albuminous envelope.

The nature of the medium in which contagious particles are suspended has the most important bearing upon the selection of a disinfectant. The presence of albumen is found to protect septic germs to a considerable extent against the action of permanganate of potassium and chlorine, but has little or no influence upon the action of sulphurous acid and carbolic acid. Dr. Baxter gives reasons for believing that the comparatively uniform quantitative action of carbolic acid upon contagia and septic microzymes, as compared with the striking differences between the disinfectant action of chlorine and permanganate upon contagia on the one hand and septic microzymes on

[1] Though disinfectant or antiseptic gases of such strength as can be tolerated in the sick-room are utterly inept as regards useful effect upon contagium, it is just possible that they may be of service in destroying or rendering incapable of change the organic matters evolved from the skin and lungs, which are always very noxious, and may be especially so in disease. These organic matters are necessarily more or less re-breathed unless the patient be placed in a current of air. If ventilation sufficient to prevent all odour cannot be provided, then some gas, such as chlorine or ozone, that will destroy the cause of the odour is certainly desirable.

the other, is chiefly or entirely due to differences in the media in which the respective particles are suspended, and not to differences in resisting power possessed by the particles themselves. This points to an important advantage enjoyed by substances like sulphurous acid or carbolic acid, which appear less influenced by the nature of the medium, and also shows the necessity of thoroughly mixing disinfectants with liquids or substances to be disinfected. The alkaline or neutral character of virulent substances led Dr. Dougall to select dilute hydrochloric acid, which has little action upon lead soil-pipes in the cold, as the best disinfectant for excreta.

A cardinal principle in disinfection is that it should be carried out at the source, or as near the source of the contagion as possible. Inunction with lard, with carbolised oil (1 to 40), or with glycerine, to clog epithelial scales, and regular washing and change of clothing, will do much to protect the purity of the air against contagium proceeding from the skin in such diseases as scarlet fever and small-pox. One of ethereal solution of peroxide of hydrogen to 8 of lard is an excellent application for the skin in typhus. Discharges from the mouth, nose, and bowels, as well as the urine, should be received in vessels containing disinfecting solutions to cover them and give protection to the air; and then larger quantities, or more concentrated solutions, as the case may be, should be thoroughly incorporated with the discharges before they are removed from the original vessels.

Of all agencies for preventing the spread of communicable disease, cleanliness is one of the most important. Facts have been adduced pointing to the conclusion that filth, when undergoing change of a fermentative or putrefactive nature, is in a condition the most conducive to the extension of infectious disease. Pending the removal of accumulations of dirt, and for the protection of workmen, fermentation may be delayed by the application of crude carbolic acid, chloride of zinc, or bichromate of potash, used in moderate quantity as antiseptics, and the whole accumulation might then be earthed over if it had to remain any time. For real disinfection the large quantity required and the mixing necessary would be prohibitory.

The ultimate fate of contagium is to be destroyed by putrefaction, and this appears invariably to destroy its specific infective power. In certain cases where real disinfection is impracticable, as in dealing with the accumulation of manure and litter from a number of animals suffering from cattle-plague, the natural processes may be hastened by stacking the material so that it shall 'heat,' or may even be destroyed by spontaneous combustion. Certainly putrefaction should not be delayed by small additions of disinfectants, which cannot accomplish the destruction of all noxious matter present.

Special Disinfectants. 1. **Heat.**—Heat, dry or moist, is perhaps the best disinfectant we possess. The experiments of Drs. Henry, Baxter, W. Roberts and others have shown the effects of this agent upon vaccine, malignant pustule, septic microzymes, scarlet fever, plague, &c. High temperature and length of exposure are, to a certain extent, mutually compensatory, but it appears that a temperature below 140° F. (60° C.) will not disinfect vaccine even with long exposure. Tyndall points out that some germs seem to be in a dormant condition, in which they resist the action of heat unless applied very long or intermittently, so as to start their vitality into growth, when they are easily killed. Experimental facts show that excessive temperatures are as unnecessary as dangerous in practical disinfection. It is extremely improbable that any contagium can withstand a temperature of 220° F. (104·5 C.), maintained during two hours. When contagium is shielded by thick material, into which heat penetrates slowly, the time necessary to reach the disinfecting temperature may be long, and hence the necessity for spreading clothing and opening out bedding in special hot-air chambers, where the heat ought not to be less than 220° F. (104·5 C.), nor more than 250° F. (121·1° C.). Hot-air chambers are usually built of brick, and are furnished with wooden supports for clothing, which should not come in contact with metal.

Dr. James B. Russell, Medical Officer of Health for Glasgow, has communicated to the writer the most important fact, that at the Infectious Diseases Hospital of that city no further disinfection of the linen and clothing of the patients is carried out than is afforded by the boiling, washing, &c., required in the judgment of the washerwomen to cleanse and dress the clothing; and yet a continuous careful scrutiny has failed to discover a single case of disease propagated by such clothing. It is probable that soda is used in the boiling, in some cases at least, and the extreme softness of Glasgow water doubtless helps by its osmotic and dissolving power.

2. **Carbolic Acid.**—A solution of this substance of the strength of 5 per cent., or 1 in 20, is the only one fit for use in disinfection. For steeping fine clothing a solution should be made from crystals. The solution generally useful is that obtained by making up one gallon of crude 80 per cent. acid to sixteen gallons with water. To disinfect a suspected liquid, an equal volume of one of these solutions is needed. The results of the experiments of Baxter and others prove that 'no virulent liquid can be considered disinfected by carbolic acid unless it contain at least 2 per cent. by weight of the pure acid.' A preparation called *Macdougall's Powder* contains carbolic acid, but is inferior to the pure kinds, though safer and more applicable in many cases to prevent odour. Judging from the light of experiments, carbolic acid vapour is quite useless, though clinically Mr. Crookes and Mr. Hope thought it of use in cattle-plague, but the animals and surroundings were drenched with liquid acid or solution. Though carbolic vapour appears impotent as regards effect upon contagium it will preserve the freshness of a bit of meat suspended in it for months. Very small quantities of the liquid acid mixed with organic fluids enables them to remain fresh and resist decay for a long time. So little as one-fifth per cent. preserves milk. It is obvious then that small quantities of this disinfectant, instead of destroying contagium, may actually preserve its

activity, when otherwise it would have succumbed to the action of natural agencies. This danger may accompany the limited use of any disinfectant that has a 'pickling' or preservative action in small quantity. Owing partly to the volatility of carbolic acid, which removes it in time, and partly to the peculiarity of its action, another danger attends its use in anything short of full strength and full doses when applied to kill contagium. The acid may, for a time, deprive the contagium of its infective power without permanently abolishing it, and the virulent properties may be regained whenever the acid has evaporated. This has been proved experimentally by Dr. Dougall, of Glasgow, who found that vaccine mixed with carbolic acid (1 in 50) *regained* its infective power after 10 days' exposure to the air.

Carbolic acid coagulates albumen when in sufficiently strong solution; while it restrains putrefaction, and limits the growth of low forms of animal life. It decomposes potassium permanganate, and therefore cannot be used in conjunction with this agent or with chlorine. Though it does not destroy sulphuretted hydrogen, it is a good deodorant in some cases. When Demonstrator of Anatomy to the University of Edinburgh, the writer experimented on a large scale with different substances for removing odour from the hands of the students, after working in the dissecting-room, and found that a 1 per cent. solution of carbolic acid is superior in efficacy to permanganate, even when strong enough to stain the skin, and is also preferable to chloride of lime. In this connection it is worthy of remark that the 'septic ferment' connected with septicæmia, erysipelas, &c., appears to be destroyed by rather less carbolic acid than vaccine requires.

3. **Sulphur Dioxide.**—The aqueous solution of this substance contains sulphurous acid. Baxter's experiments show that it is the most potent volatile disinfectant known; and as it is very soluble, and is little affected by the presence of albumen, it is also powerful in the disinfection of liquids. It destroys sulphuretted hydrogen thus, $SO_2 + 2H_2S = 2H_2O + S_3$, and combines with ammonia. A strong solution of sulphurous acid is sold, but is difficult to use, on account of its suffocating odour. The solution can be made by deoxidizing hot concentrated sulphuric acid with copper-turnings or charcoal. For aërial disinfection the best plan is simply to burn sulphur in very large quantities. This disinfectant forms sulphites, and is a reducing or deoxidizing agent, in the first place, for it unites with the oxygen of many compounds to form sulphuric acid; but it may give up oxygen, and when mixed with much vegetable matter the sulphur may come off as sulphuretted hydrogen. Sulphur dioxide and chlorine, as well as this substance and permanganate of potash, mutually destroy each other, and therefore should not be used together. Sulphur dioxide destroys the activity of dry vaccine on points very rapidly, and even when much diluted stops the amœboid movements of living cells, kills vibrios, and acts deleteriously on vegetation. 'Whether chlorine or sulphur dioxide be chosen, it is desirable that the space to be disinfected should be kept saturated with the gas for not less than an hour.' 'A virulent liquid cannot be regarded as certainly and completely disinfected by sulphur dioxide, unless it has been rendered permanently and strongly acid. The greater solubility of this agent renders it preferable, *cæteris paribus*, to chlorine and carbolic acid, for the disinfection of liquid media' (Baxter). According to Baxter's experiments, a larger percentage of sulphur dioxide than of carbolic acid is required for the disinfection of the virus of infective inflammation, but a smaller percentage for other contagia. Sulphur dioxide preserves meat and other substances, when in closed vessels, for very long periods. It bleaches vegetable colours, attacks iron, and is absorbed by cloth and leather—facts to be remembered in practical disinfection. 1 lb. of sulphur, when burned, produces 11·7 cubic feet of sulphur dioxide gas.

4. **Chlorine** is most easily obtained from chloride of lime or bleaching powder, by adding hydrochloric or sulphuric acid. Exact proportions cannot be stated, as the value of the bleaching powder varies; but rather more acid than equal parts of bleaching powder and strong hydrochloric acid may be taken. The acid should be diluted before use. Another method is to pour strong hydrochloric acid upon heated binoxide of manganese; this method of disinfection is impracticable compared with burning sulphur. For deodorizing water-closets, some crystals of potassium chlorate may be thrown into a wide-mouthed bottle containing dilute hydrochloric acid. Euchlorine comes off gradually, and is both more effective and more agreeable than chlorine. The most marked character of chlorine is its strong affinity for hydrogen, which enables it to break up compounds containing that body, and to set free in a nascent or active state the oxygen combined with hydrogen in water. It is, therefore, one of the most universally applicable and powerful deodorizers in existence. Direct experiment shows that 'there is no security for the effectual fulfilment of disinfection short of the presence of free chlorine in the virulent liquid, after all chemical action has had time to subside.' Chlorine is soluble in water to the extent of $2\frac{1}{3}$ volumes in one, and this solution may be used for disinfection. When merely used as a deodorizer, enough euchlorine may be expelled from moist chloride of lime by the carbonic acid of the air for most purposes.

5. **Permanganate of Potassium.**—This substance is non-poisonous, and is a good deodorant, especially for the emanations from organic bodies. It is, moreover, free from odour, and its aqueous solution shows, by loss of colour, when it is exhausted. It is a very suitable deodorant for the sick-room, as, when dissolved in water and a large surface of the solution exposed to the air, it will absorb gases to some extent. Contagium being non-gaseous, is not affected, unless in contact with the solution. Permanganate of potassium is a true disinfectant, oxidizing and destroying contagia as well as putrid matters; but the quantity required and the price render its use almost impossible, for enough permanganate has to be used to destroy the medium or vehicle bearing contagium as well as the contagium itself. Condy's fluid is

a solution of this substance in water. 'When permanganate of potash is used to disinfect a virulent liquid containing much organic matter, or any compounds capable of uniting with the permanganate, there is no security for the effectual fulfilment of disinfection, short of the presence of undecomposed permanganate in the liquid, after all chemical action has had time to subside' (Baxter). When the virulent liquid or matters are small in quantity, permaganate solution forms a capital receptacle, and may stand by the bedside as a deodorant till required as a disinfectant. The safe rule in employing permanganate as a disinfectant is to add it and mix till the colour is retained. Permanganate has no effect in restraining the appearance of bacteria, or preventing the onset of putrefaction.

6. **Acids.**—The mineral acids and glacial acetic acid have all disinfecting power when used in sufficient quantity; but, except sulphurous acid, there are serious difficulties in the way of their use, and we have better disinfectants. Hydrochloric is inferior to chlorine as a gaseous agent; but the solution is extremely cheap, and is useful for disengaging chlorine, as well as for employment as a disinfectant. Chromic acid, which has remarkable power in preventing putrefaction and killing microzymes, is too dear to be used outside the laboratory.

7. **Nitrous Acid.**—Nitrous acid can be easily disengaged as a gas by putting bits of copper into nitric acid, or pouring nitric acid upon sawdust or starch. It is the best deodorant for the deadhouse, and, without doubt, it is a vigorous disinfectant, but is too dangerous for ordinary use, as it may easily be breathed in quantity sufficient to cause fatal bronchitis.

8. **Chloride of Lime.**—Bleaching-powder gives off chlorine easily, and this probably explains its disinfecting power. It is very cheap and manageable, and hence of much importance.

In regard to the agents hitherto considered, we have more or less of the sure light of direct experiment upon contagium; but the claims of the following and a legion of other substances asserted to be 'powerful disinfectants, of which it is impossible to speak too highly,' rest entirely upon chemical theories, or the opinions of physicians, or upon their power of coagulating albumen, or of delaying or preventing putrefaction and fermentation, or of deodorising. It will be scarcely necessary to do more than enumerate the best, as follows:—

9. **Metallic Salts**, including—*a. Bichromate of Potash. b. Sulphate of Copper. c. Chloride of Zinc* (*Burnett's Fluid*) which can be made very cheaply by pouring hydrochloric acid upon calamine, the native carbonate, or upon zinc. It seems to be the most useful of the metallic salts. *d. Chloride of Aluminium. e. Ferric Chloride*, which, if strong, liberates offensive fumes from animal matters, but is a fair antiseptic and preservative. *f. Ferrous Sulphate. g. The Waste Chlorides*, from the manufacture of chlorine, contain $MnCl_2$, Fe_2Cl_6, and free HCl, which cost next to nothing, and might be used for larger masses of filth or drains.

10. **Ozone.**—This body, got by half immersing a stick of phosphorus in tepid water, or mixing gradually 3 parts strong sulphuric acid and 2 parts permanganate of potassium, oxidises organic matter, and so destroys odours. Terebene and cupralum, a preparation containing terebene, are good deodorants, and give rise to ozone.

11. **Charcoal.** — Charcoal condenses gases within its pores where combustible gases are destroyed by the condensed oxygen. Contagium, unless in water, does not enter the pores, for, being particulate, it is not absorbed from the air as gases are.

Practical Disinfection.—In conclusion a few remarks may be offered as to the modes of carrying out disinfection under circumstances in which it is commonly required.

1. **Clothing and bedding.**—In dealing with the ragged and worthless articles of the poor, local authorities will generally find it most satisfactory to both parties to burn them and replace with new. By such discreet generosity danger is averted, and good-will created, which helps in getting early information and carrying out measures, and so, by shortening epidemics, saves expense. If not burned, clothing may be baked (*see* Heat), or well boiled with soda. Before coming to the washhouse they may steep in 5 per cent. carbolic solution, or chloride of zinc (1 to 240), or chloride of lime (2 oz. to the gallon).

2. **Rooms.**—The foundation for disinfecting rooms is thorough cleansing with soft soap and hot water, which may contain 5 per cent. carbolic acid, but the carbolic solution is not so easily handled. The walls and ceiling should be brushed, and wall-paper removed. Furniture, if iron, is to be washed with carbolic solution, and removed from the room. Textile fabrics should be baked or boiled, or spread out in the room for fumigation, but this is not so effective, and colours are bleached. The chimney, doors, and windows are to be closed, and crevices covered with paper pasted on. Then one or more tubs of water are to be placed in the room, and an earthenware saucer containing sulphur placed over each, supported by a pair of tongs laid across to prevent danger from fire. The sulphur can be lighted by pouring a little alcohol upon it, or by means of a live coal. The usual rule is to use 1 lb. of sulphur for each 1,000 cubic feet of space, but this only gives 1·17 per cent. SO_2 to the air, and 3 lbs. is a more satisfactory quantity. The door is to be shut until next day, when the windows and doors are all to be opened, and kept open for twenty-four hours. In whitewashed rooms the walls should be scraped, and then washed with hot lime in addition to the fumigation.

3. **Drains, Water-closets, &c.**—Proper drains remove sewage so swiftly and completely, that little or no sewage-gas is formed if ventilation is given. For bad drains carbolic acid, chloride of zinc, or waste chlorides from the manufacture of chlorine are fair palliatives. The excreta from cases of infectious diseases require a very large quantity of disinfectant, which should be applied in a concentrated form before they are thrown into the water-closet or house pipes. When a reliable amount of disinfectant is in these cases sent down the pipes, it is apt to corrode them unless it has been allowed to

expend its energy on the excreta alone in the first place. If small quantities of disinfectants are poured down water-closets, it is better to mix them with the after-flush water which fills traps and basins, so that the little energy available may be devoted to the destruction of any slime adhering, or portions of organic matter retained. Permanganate of potash is the most pleasant agent for this purpose, though expensive. Chloride of zinc, from its cheapness and preservative power, is worthy of mention. When there are no water-closets, the excreta in cases of cholera and typhoid fever should be received in a vessel containing half a pint or more of a 1 in 20 solution of commercial hydrochloric or sulphuric acid, and then put along with some chloride of lime into a covered stoneware vessel in the back yard. After a few hours the contents of this vessel may be thrown into the cesspool or upon the midden.

4. **Dead bodies**, if putrid or bearing contagium, should be wrapped in sheets wet with 1 in 20 carbolic solution, or 1 in 40 chloride of lime; or, if coffined, sawdust saturated with one of these solutions should be packed around them.

It is necessary clearly to keep in view the object desired when selecting disinfectants, deodorants, or antiseptics; whether it be destruction of contagium, merely 'pickling' and preserving, arresting putrefaction and fermentation, or deodorisation. From all that has been said it is evident that the different 'disinfecting' nostrums, applied as their inventors direct, can have little effect upon contagium, but may have more or less power in the other directions indicated. JAMES A. RUSSELL.

DISLOCATION OF ORGANS (*dis-*, apart, and *locus*, a place). *See* ORGANS, Dislocation of.

DISPLACEMENT OF ORGANS. *See* ORGANS, Displacement of.

DISSECTION-WOUNDS. *See* POST-MORTEM WOUNDS.

DISTOMA (δίς, double, and στόμα, a mouth).—SYNON.: Fluke; *Fasciola*; Fr. *distome*; Ger. *Leberwurm*.—A genus of trematode parasites, vulgarly called flukes. The term was founded by Retzius in 1786; but the title Fasciola, previously employed by Linnæus, is the more correct, especially when applied to the common liver-fluke, which is an occasional inhabitant of the human body. Nearly twenty instances of the occurrence of this parasite (*Distoma hepaticum* of some writers) in man have been placed on record. Besides infesting the liver-ducts and gall-bladder, it has been found under the skin behind the ear (Fox), beneath the scalp (Harris), and in the sole of the foot (Giesker).

Several other species of fluke are known to infest mankind, but with the exception of the Egyptian hæmatozoon (*Bilharzia hæmatobia*) none of them are of frequent occurrence. Thus the lancet-shaped fluke (*Distoma lanceolatum*) has thrice occurred, leading to a fatal result in a single instance, whilst the minute *Distoma hysterophytes* has only once been recorded. The large human fluke, sometimes known as Busk's fluke (*Distoma crassum*) had also, until lately, only once been noticed; but, through Dr. George Johnson, the writer has become acquainted with two more instances of infection from this parasite, and there is some ground for believing that the cases of fluke described by Dr. Leidy of Philadelphia refer to the same parasite. More recently also (*Lancet*, 1875) Dr. McConnell has recorded the occurrence of an undoubtedly new species from a Chinese, for which the writer has proposed the title of *Distoma sinense*. Large numbers infested the ducts of the liver. Professor Leuckart subsequently proposed the term *Distoma spathulatum*. Professor McConnell has also discovered another fluke in man (*D. conjunctum*, Cobbold) previously only known to infest the fox and dog. Taken as a whole the human flukes referable to the genus *Distoma* have very little clinical importance; but, since there were striking symptoms in connection with the above-mentioned cases of *Distoma crassum* (affecting an English missionary and his wife during their residence in China) it may be as well to mention that these large parasites, individually varying from one to three inches in length, appear to be capable of inducing severe diarrhœa and colic. Their organisation is totally distinct from that of the common fluke. They probably never gain access either to the liver or its ducts. (*Proceed. Linn. Soc.*, Feb. 1875.) The administration of santonine, male fern, and other anthelmintics has been unattended with positive results; those specimens that were expelled seeming to have been, as it were, starved out by the patients having been put upon a milk diet, recommended by Dr. Johnson. The missionary and his wife having returned to China were again attacked by *Distoma crassum*. In the spring of 1878, they again consulted the writer in London, not only on their own account, but also on behalf of one of their children, a little girl, who had also contracted the fluke-disorder in China. Flukes have twice or thrice been detected in the eye, but they appear to have been sexually immature worms, referable probably, as Leuckart has suggested, to the *Distoma lanceolatum*. The flukes described by Treutler and Delle Chiaje, if genuine, have no clinical importance. *See* BILHARZIA. T. S. COBBOLD.

FIG. 16. *Distoma conjunctum* × 4 diameters. After McConnell.

DIURESIS (διά, through, and οὐρέω, I pass water).—A free excretion of urine, whether natural or artificially induced.

DIURETICS (διά, through, and οὐρέω, I pass water).

DEFINITION.—Remedies which increase the secretion of urine.

ENUMERATION.—The following comprise the most important diuretics:—Water; salts of Potash, Soda, and Lithia; Alcohol, Nitrous Ether, Turpentine, Juniper, Copaiba, Cantharides, Digitalis, Squill, Tobacco, and Scoparium. The action of diuretics is often aided by brisk purgation, depletion, counter-irritation over the loins, and sometimes by the use of mercury.

ACTION.—The secretion of urine appears to consist partly of mechanical filtration of fluid

through the glomeruli of the kidney, and partly of secretion by the cells of the urinary tubules. The filtration in the glomeruli is increased by anything which raises the blood-pressure throughout the system generally, or in the renal arteries locally. The systemic blood-pressure may be raised by cold to the surface, digitalis, squill, and tobacco. Digitalis, and possibly other drugs have also a local action on the renal arteries, which are more readily affected by some drugs than other arteries in the body. The exact mode of action of the other diuretics is not determined, but common salt, nitrate of potash, urates, and urea increase the flow of urine, even although the pressure in the vessels of the kidney is very low. It is therefore probable that they stimulate secretion by acting on the nerves or cells in the kidney itself.

Uses.—Diuretics are employed to increase the flow of urine, and thus remove water or excrementitious products like urea from the body. They are used in cases of general dropsy, or of accumulation of fluid in the peritoneum or pleura. In febrile conditions they are given to aid in the elimination of waste matter. They are also employed in order to render the urine more watery, and thus prevent the deposition of solids from it, and the formation of calculi in the kidney or bladder, or to redissolve such concretions when they are already formed. Digitalis and squill are most useful in dropsy dependent on heart-disease; the other remedies are more effective in dropsy dependent on disease of the kidneys or liver. The action of digitalis and squill is greatly assisted by the addition of a little blue pill, and when the kidneys are much congested or pressed upon from without by accumulation of fluid in the abdominal cavity, diuretics sometimes fail to act until the congestion has been relieved by depletion from the loins or the use of a brisk purgative, and the pressure removed by paracentesis. T. Lauder Brunton.

DIZZINESS. *See* Vertigo.

DOCHMIUS (δόχμος, twisted).—A genus of nematoid worms established by Dujardin. *See* Sclerostoma.

DOTHINENTERITIS (δοθιήν, a pustule, and ἔντερον, the intestine).—A synonym for a form of enteritis, accompanied by an enlargement of the follicles, which causes them to resemble pustules. *See* Intestine, Diseases of.

DOUCHE (Fr.).—Definition.—A jet of water propelled against some part of the body through a *doccia* or pipe. The size of the jet of water, the degree of its impetus, and its temperature, can all be regulated. A douche differs from simple affusion in its application, being more local, and the force with which it is applied being greater.

Application and Action.—Douches of cold and of hot water, of vapour, and occasionally of gas are employed; but those by far the most commonly used, except where there are hot natural waters, are of cold water.

The immediate effect produced by a cold douche on those who are unaccustomed to it is a feeling of shock, spasmodic shortness of breathing, palpitation of the heart, and sometimes pain in the back of the head. Locally the first effect of a douche is to deaden the sensibility of the part to which it is applied; but if the douche be powerful enough, reaction of the part comes on in about forty seconds. This continues for a time; but if the douche be kept up for three or four minutes, the pulse falls seven or eight beats, the deadening of sensibility returns, and the temperature of the part is greatly lowered; when the douche is withdrawn reaction again takes place. This alternate sedative and stimulating effect, producing emptiness and turgescence of the vessels, quickens the action of the capillaries of the part, and thus favours the transmutation of tissue. The mechanical effect of the force with which the douche is applied must not be overlooked. If great, it produces the highest amount of stimulation, which may almost amount to inflammation.

Different portions of the body have different degrees of tolerance of the douche. Thus the extremities and the head bear it better than the chest, and the chest somewhat better than the abdomen; and the posterior aspect of the body bears it much better than the anterior. Patients soon get accustomed to the cold. Warm douches produce less shock, and are more easily borne, but they are, comparatively speaking, little employed in private houses. An alternation of hot and cold douches, known somehow by the name of *Scotch*, is a valuable remedy; in it the hot water rapidly restores the irritability of the part deadened by the cold water, and there is a maximum of action and reaction of the part obtained. Under particular circumstances it may be expedient to use a jet of steam, but this, of course, must be used with caution; and a jet of carbonic acid is sometimes propelled against the eye or ears, or the neck of the uterus. What are called *ascending douches* are used for the rectum or the vagina. Douches for the eye and the ear have been used of late years. In a certain sense what the English call *pumping* is a variety of the douche, and the *shower-bath* is in reality merely a multiplication of fine douches. The action of douches is more or less general according to the portion of the body to which they are applied. Thus the application of a douche to the head has the most general action, and that to the spine the next so. In either case it is impossible to limit it very strictly, and there is a certain amount of affusion besides the direct douche. A douche, again, applied to one of the extremities may easily be localised; and a douche may be applied only to one part or to several parts of the body in succession.

Douches merely require a pipe with nozzles of various sizes in connection with a cistern at a certain elevation, or with a pumping machine, and can easily be improvised. Shower-baths can be procured with equal facility. A vapour douche can be got by attaching a pipe to a vessel of boiling water. In the case of the fine douches used for the eye, the water is propelled with sufficient force by the action of a caoutchouc bag worked by the hand. Carbonic acid is practically little used, and only where there is an abundant natural supply of the gas.

Perhaps 50° may be considered the average temperature of a cold douche, and from four

minutes to a quarter of an hour its average duration. The course of douching will probably extend at least over a fortnight. As to the actual temperature of the water, the sensation it produces in the patient depends most on his condition. Thus water of 45° may feel ice-cold to one who has just quitted a hot bath. In like manner a douche of slightly-heated water may appear quite warm when applied to a part cooled by a cold douche. The temperature of a douche should vary according to the condition of the patient.

Uses.—As a general rule we may say that douches are only applicable in cases of chronic disease; that cold douches are most useful in constitutional diseases; and that warm douches, and the alternation of hot and cold, are most suitable in local affections.

The cold douche, when it is employed gradually and with judgment, is found serviceable in chlorotic and hysterical conditions, in hysterical paralysis, and in over-sensibility of the skin, with tendency to catch cold; and of late years it has formed a part of the special treatment of phthisis in elevated places. As cold affusion on the head is very serviceable in infantile convulsions, so the application of a douche of cold water to the head is a calmative and hypnotic in maniacal cases. It is, perhaps, not so much used in this way as formerly, as it has, like the shower-bath, come to be considered a sort of punishment to troublesome lunatics. Still it is a valuable agent. Hydropathic practitioners have found douches useful revulsives in congestion of the liver and of the uterus.

Locally douches have been used, but with moderate benefit only, in some cases of skin-affections and of chronic ulcers. Their principal local application, however, is in cases of old sprains, in chronic rheumatism or gouty thickenings of joints, in lumbago, in some neuralgias, and in paralysis when it is not too recent. The *Scotch* is far the most effective for these purposes, and there seems to be some evidence of its having been efficacious in threatened tabes dorsalis—certainly more efficacious than any other remedy. Douching might be used more extensively in private houses; still, as assistance is always required by the patient, public baths have advantages for their application.

John Macpherson.

DRACUNCULUS (*dracunculus*, a little dragon). — A synonym of the guinea-worm. Under this title the parasite was described by Lister (*Phil. Trans.*, 1690), and afterwards by Kaempfer (1694). Following the latter authority the writer has elsewhere recognised the term as of generic value, but the majority of helminthologists, after Gmelin, prefer to place

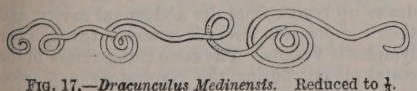

Fig. 17.—*Dracunculus Medinensis*. Reduced to ½.

the worm under the genus *Filaria* (*F. medinensis*). The Dracunculus was known before the time of Lister, having been described in a remarkable work by Velscius (1674) and by Agatharchidas as quoted by Plutarch. There is indeed, every reason to believe that the so-called fiery serpents of Moses answer to the dracunculi of Plutarch. The matter is fully and learnedly discussed in Küchenmeister's treatise (*Parasiten*, S. 305; also in the English edition, p. 390 *et seq.*). *See* Guineaworm. T. S. Cobbold.

DRAINAGE. *See* Public Health.

DRASTICS (δράω, I act).

Definition.—Violent purgatives.

Enumeration.—The drastics most frequently employed are:—Hellebore, Podophyllin, Gamboge, Elaterium, Scammony, Jalap, and Croton oil.

For action and uses of drastics, *see* Purgatives. T. Lauder Brunton.

DRIBURG, in Westphalia. Strong Chalybeate Waters. *See* Mineral Waters.

DROITWICH, in Worcestershire. Common Salt Waters. *See* Mineral Waters.

DROPSY (ὕδρωψ; from ὕδωρ, water, and ὤψ, aspect, appearance).—Synon.: Fr. *Hydropisie*; Ger. *Wassersucht.*

Definition.—Accumulation of serous fluid in the subcutaneous cellular tissue, or in a serous cavity.

Dropsy is known by various other names, according to the portion of the body affected. When confined to the subcutaneous cellular tissue it is termed *œdema* or *anasarca*; to the peritoneal cavity, *ascites*. The term is often limited to these two forms of the disease; and exudations similar to that of ascites in other cavities are termed *hydropericardium*, *hydrocephalus*, *hydrocele*, *hydrops oculi*, *hydrops articuli*, and *hydrothorax* or *pleural effusion*, according as they are contained in the pericardium, arachnoid, tunica vaginalis, eye, joint, and pleura respectively.

Pathology.—The accumulation of fluid in the tissues, or in a serous cavity, depends upon more fluid exuding from the blood-vessels than can be taken up by the absorbents. So long as no obstruction to absorption occurs, it rarely happens that more fluid can exude from the blood-vessels than the absorbents can again take up. Absorption is partly carried on by the veins, and partly by the lymphatics; principally, however, by the veins. When venous obstruction takes place, fluid is apt to accumulate in that part of the body from which the blood ought to return by the obstructed vessel. But it does not always so accumulate; for it may happen that the lymphatics are able to absorb all the fluid which exudes from the capillaries, and to return it into the general circulation. Thus it has been found by Ranvier that ligature of the vena cava in a dog does not usually produce œdema of the lower extremities, but if one sciatic nerve be divided in such an animal, the corresponding leg at once becomes œdematous. The reason of this is that so long as the nerve is intact, the lymphatics can absorb all the fluid which exudes from the capillaries, but when the nerve is divided the arteries dilate, more fluid is poured out than the lymphatics can absorb, it accumulates in the tissues, and œdema ensues. This œdema is not due to

paralysis of the limb, but to paralysis of the vessels. For if the sympathetic fibres through which the vaso-motor nerves pass to the sciatic nerve are divided before they join the motor fibres of that nerve in the sacral plexus the power of movement remains unimpaired, but œdema occurs just as if the whole nerve had been divided. If, on the other hand, the motor strands of the sacral plexus are cut before they are joined by the sympathetic fibres, the limb is as completely paralysed as if the sciatic nerve had been cut, but no œdema takes place. Any obstruction to the venous flow will operate in the same way as ligature of a vein, though to a less extent, the effect varying according to the amount of obstruction. Thus regurgitation of blood through the tricuspid valve tends to produce general anasarca, and obstruction to the portal vein by cirrhosis of the liver tends to cause accumulation of fluid in the abdominal cavity.

It has been mentioned how great an influence dilatation of the arteries from vaso-motor paralysis has upon the *production* of œdema in cases where the veins are obstructed. Arterial dilatation may also produce a local œdema, even when no such obstruction is present, as, for instance, in the tissues around an inflamed part. It has been shown, however, by Winniwarter, that the walls of vessels in an inflamed part are more permeable, and allow fluids to pass through them more easily than healthy vessels will do. It is probably in consequence of this that we find that a slight stimulus, such as scratching the skin, which ordinarily produces in a healthy person only slight dilatation of the capillaries, and consequently redness of the part scratched, will produce an effusion from the vessels, and local swelling of the part at the point scratched in persons suffering from urticaria. The same thing takes place when the skin is scratched in the neighbourhood of a part stung by a wasp.

But this alteration in the vessels is not the only cause of the œdema, which may occur without any obstruction to the circulation. An alteration in the composition of the blood appears to allow it to permeate more easily into the tissues, and to produce œdema, even when there is no obstruction of the veins. In cases of anæmia we find œdema occurring at the ankles, although there is no obstruction to the venous circulation other than that caused by the weight of the column of blood itself. In these cases, however, we have dilatation of the vessels, as is shown by the form of the sphygmographic tracing, and an altered composition of the blood is evidenced by the anæmic look of the patient. The dropsy of scurvy is probably also due to blood-vascular disorder. In albuminuria the altered composition of the blood appears to be the chief factor in the production of œdema, as the pulse in such cases may be hard, evidencing arterial contraction, and not relaxation.

Ætiology. — General dropsy affecting the subcutaneous tissue, the peritoneal cavity, and the internal serous cavities and organs generally, is usually the result of albuminuria, and most frequently of that form which depends on fatty degeneration of the kidney. In cirrhotic disease of the kidney the loss of albumen in the urine is much less, and the alteration in the composition of the blood consequently is not so great as in the first-mentioned form. The arterial tension also is greater than usual, instead of being less. In the amyloid form the œdema is generally moderate.

The next most common cause of dropsy is tricuspid regurgitation, obstructing the venous circulation throughout the body. This regurgitation generally depends on dilatation of the right ventricle consequent upon obstruction to the flow of blood through the lungs, either from chronic bronchitis and emphysema, or mitral obstruction and regurgitation. Dropsy from cardiac disease generally appears first in the feet if the patient has been for some time in an upright position, while dropsy from albuminuria is often first remarked by a puffiness of the eyelids. In the former it appears where the greatest obstruction to re-absorption takes place, and in the latter case in those parts where looseness of the cellular tissue most readily allows of exudation.

Local dropsies have, as a rule, local causes. Even the swelling of the feet in anæmic young women, although dependent on a general cause, viz., dilatation of the vessels, and altered composition of the blood, is determined locally by the greater obstruction to the venous circulation which the pressure of the long column of blood in the veins between the feet and the heart presents. In general dropsy also, those parts which are most dependent are apt to become most swollen. It is not, however, always so, as in certain cases the dependent parts have been noticed to be less dropsical than the others. This curious phenomenon seems to be due to some vaso-motor nervous influence on the vessels of the dependent part. The local œdema of a brawny character, often noticed around inflamed parts, is partially due to swelling of the tissues themselves, and partially to effusion of fluid between them. This effusion, as has already been mentioned, appears to be caused both by the dilatation of the vessels observed in inflamed parts, and by the greater readiness with which fluids pass through them.

Dropsy in Serous Cavities.—The serous cavities of the body, the arachnoid, pleura, pericardium, peritonæum, &c., are now known to be large lymph-sacs, in communication with the general lymphatic system of the body. The fluid which exudes into them from the blood vessels is, in the peritonæum and pleura, removed, at least in part, by a pumping action in the movements of respiration. The central tendon of the diaphragm contains spaces, the walls of which are alternately drawn apart and pushed together during its ascent and descent. Their separation draws up lymph from the abdominal cavity, and their compression forces it onwards through the lymphatic vessels. The same thing occurs in the costal pleura, during the respiratory expansion and contraction of the chest. The accumulation of fluid in serous cavities may be due, like its accumulation in the cellular tissues, either to diminished absorption or increased exudation. The diminished absorption occurs here in consequence of pressure upon veins, and possibly also

from interference with the pumping action just described. Accumulation of fluid in the ventricles of the brain, or in a sub-arachnoid cavity, is chiefly due to compression of the veins of Galen. In the peritonæum it may be due to obstruction of the portal vein by cirrhosis of the liver or by the pressure of tumours, and it may occur to a greater or less extent in all cavities of the body—from general obstruction of the venous circulation, by disease of the heart or lungs, in the same way as anasarca. It may also occur in these cavities from alteration in the blood, as in Bright's disease. Active dropsy may occur in a serous cavity from inflammation, and here the exudation of fluid is much more rapid than in passive dropsy, the vessels of the inflamed part being dilated and more pervious than usual.

Treatment.—The first thing to be considered in the treatment of dropsy is the removal of its cause, if this be at all possible. Where it is due to obstruction of a vein we must hinder, as much as possible, the accumulation of fluid in the vein, by preventing the part from remaining in a dependent position, while at the same time we try to aid the absorption of fluid by the lymphatics by gentle upward friction. Where it is due to obstruction of the circulation in the lungs, we must diminish, as far as possible, all obstructions to the pulmonary circulation by inhalations, emetics, and expectorants, pushed if necessary so far as to cause nausea or even vomiting. Where, the obstruction is due to dilatation or valvular disease of the heart, we must aid the organ to contract more powerfully by the use of cardiac stimulants, such as alcohol and digitalis. Digitalis probably has a threefold action in cardiac dropsy, by strengthening the heart, by contracting the vessels, and by stimulating the kidneys. It strengthens at the same time that it slows the cardiac pulsations, and by making the heart contract more powerfully it keeps up the onward current of the blood more efficiently, and at the same time lessens the dilatation which tends to render the valves incompetent. Besides its effect on the heart, digitalis has also an action on the vessels, causing the arterioles to contract, and probably reducing the dropsy in this way. For the contraction of the arterioles produced by digitalis is exactly the converse of the condition which occurs after division of the vaso-motor nerves, and which, as we have seen, produces dropsy whenever any obstruction of the circulation exists. It is not known at present whether digitalis also causes increased absorption, but it seems highly probable that it does so, because we know that it stimulates the vaso-motor centre, and stimulation of this part of the nervous system has been shown by Goltz to increase greatly the rapidity of absorption from the lymph-sac of the frog. In addition to this action on the heart and vessels generally, digitalis possesses a specific action upon the vessels of the kidney. It is a powerful diuretic, and by thus lessening the amount of water in the blood it will tend to increase the absorption of serous fluid either from the cellular tissue or serous cavities. When digitalis alone does not succeed, the addition of squill and of a small quantity of blue pill frequently increases its efficacy. Digitalis succeeds best in dropsy caused by valvular disease or dilatation of the heart. It is not so useful in dropsy arising from renal disease, and here other diuretics are preferable. One of the best is spirits of juniper, given either as a mixture or in the form of Hollands gin. Spirits of nitrous ether, nitre, bitartrate of potash, and broom are useful in all forms of dropsy. Copaiba occasionally succeeds where other diuretics fail. It seems to be most successful in dropsy due to cirrhosis of the liver. Hydragogue cathartics, such as compound jalap powder, elaterium, &c., which cause copious watery secretion from the intestines, supplement the action of diuretics, and by removing water from the body, as well as altering its nutrition, relieve or remove dropsy. In some cases of Bright's disease considerable relief has been obtained by the profuse sweating induced by vapour baths, hot-air baths, jaborandi, or pilocarpin. When the dropsy does not yield to other remedies, the fluid must be removed by paracentesis in the case of serous cavities, and by very small superficial incisions or punctures, or by the insertion of very fine trochars with drainage-tubes attached, in the case of the limbs.

T. Lauder Brunton.

DROWNING, Death by.—Drowning is employed, in an extended sense, to signify death from submersion in a liquid medium, and in a more restricted sense to signify death in consequence of obstruction of respiration so caused. Now, though death must necessarily ensue from asphyxia, when the air-passages are submerged, apart from any other complication, asphyxia is not always the mode of death in those who were alive at the moment of submersion. For death may result from mechanical injuries, concussion, shock, syncope, or apoplexy in the very act, or at the moment, of falling into the water. Devergie estimates that 12·5 per cent. of deaths occur from one or other of these causes. In the remaining 87·5 per cent., the phenomena of asphyxia pure and simple are present only in 25 per cent., while in 62·5 per cent. these are more or less modified by the causes above-mentioned, to which must be added the benumbing influence of cold.

When death is not sudden from shock, &c., the ultimate result is the same in the swimmer or non-swimmer, if there be no escape or rescue. All efforts to keep above water fail, vain clutchings are made at whatever comes within reach, water is drawn into the lungs and more or less swallowed, all struggles finally cease, and the body sinks.

The indications of such instinctive efforts form the most important evidence of submersion during life. Drowning is not necessarily to be inferred in the case of a dead body removed from the water; for the body may have been thrown in after death from other causes—asphyxia among the rest.

The Evidence of Death from Drowning is cumulative, for we can scarcely say that there is any one indication invariably present which can be looked upon as due to drowning and nothing else. But one or other, or more, of the following appearances are generally found.

External.—The face is either pale, or more or less livid, or frequently bloated if the body has

lain some hours in the water. Foam at the mouth and nostrils is very common; and the tongue is swollen and congested, closely applied to the teeth, or even clenched between them. The skin is pale, or marked here and there by livid discolorations, and the muscles of the hair-bulbs are rigidly contracted, causing the appearance of goose-skin, or *cutis anserina*. The penis is remarkably retracted, so that it appears quite small in proportion to the size of the individual.

Indications of struggling are frequently seen in excoriations of the hands, mud and sand under the nails, or even weeds, straws, or other small objects, tightly clenched in the hands.

Internal.—The trachea, bronchi, and smaller air-tubes are congested and filled with a mucous froth, more or less tinged with blood. The lungs themselves are congested, œdematous, and pit on pressure. Pressure on them causes froth to exude into the smaller bronchial tubes, and on section a sanguinolent froth and water escape. Indications may be seen of sand, mud, or small weeds drawn deep into the air-passages along with the water in which submersion took place.

The stomach contains water. If this has any special character by which it can be identified with that in which submersion occurred, and not likely to have been drunk to quench thirst, it excludes the theory of its having been swallowed before submersion; and is a strong presumption, if it cannot be said to be a certainty, that it was swallowed during the death-agony, and did not find its way into the stomach after death. The same may be said of water in the lungs.

The right side of the heart and venous system in general frequently present the appearances characteristic of asphyxia; and the brain is often congested.

Without relying on any one sign as conclusive, we may say that a body which exhibits goose-skin, retraction of the penis, excoriations, &c., of the hands, froth at the mouth, water in the lungs and stomach, and congestion of the right heart and venous system, certainly died from drowning. In the presence of some and in the absence of other indications, a careful weighing of all the facts is necessary; but in most cases a satisfactory conclusion can be arrived at.

Complete submersion is usually sufficient to cause death within two minutes; but cases have been recorded of resuscitation after a much longer period. Many of these can be attributed to the exaggerated estimation of time by anxious on-lookers; but there are other well-authenticated instances, which may be explained by the supervention of syncope and temporary cessation of the respiratory process. That which renders resuscitation after submersion less likely than after a corresponding period of mere suffocation is the entry of water into the lungs by aspiration.

Treatment.—The treatment of the drowned consists in the persistent use of artificial respiration (*see* Artificial Respiration, and Resuscitation) so long as any signs of life remain, together with the application of means to counteract the great abstraction of body-heat which occurs even when the aërial temperature is comparatively high. Before commencing the movements of artificial respiration, the mouth and nostrils should be freed from water and froth, by holding the head somewhat low, face downwards, for a few seconds. Artificial respiration should then be immediately proceeded with; and at the same time the wet clothes should be removed, and the body wrapped up in warm clothes obtained from bystanders, pending the arrival of warm blankets, hot bottles or bricks, &c., from the nearest house. Assiduous friction of the extremities should also be kept up. These directions—artificial respiration excepted—naturally presuppose assistance. If this be not at hand, the operator must rely mainly on artificial respiration. In the performance of artificial respiration by Sylvester's method, especial care must be taken against pressing on the stomach, for as it so frequently contains water, this may be pressed up the œsophagus, and drawn into the lungs by the next inspiratory movement.

When spontaneous respiratory movements commence, attention should be directed to maintain life, by the application of warmth externally, assiduous friction of the limbs upwards, and the administration of a teaspoonful of brandy and water, wine, or coffee. Lung-complications should be watched for and counteracted.

D. Ferrier.

DROWSINESS.—Inclination to sleep. *See* Sleep, Disorders of.

DRY.—A term applied to certain morbid conditions, to express the entire or comparative absence of fluid exudation or secretion, which is often present in such conditions; for example, Dry Gangrene, Dry Cavity, Dry Catarrh, and Dry Pleurisy. The word is also associated with certain ausculatory signs, which convey the impression of want of moisture; for example, Dry Rhonchus and Dry Crackle. *See* Physical Examination.

DUCHENNE'S PARALYSIS. *See* Pseudo-Hypertrophic Paralysis.

DUCTUS ARTERIOSUS, Patency of.—*See* Heart, Malformations of.

DUMBNESS.—Definition.—The condition of an individual incapable of articulating sounds.

Dumbness may arise from a variety of causes, and its prognosis and treatment vary accordingly.

1. **Dumbness due to Deafness.**—The most frequent cause of so-called dumbness is congenital or early acquired complete deafness, or defective power of hearing, so that the patient is unable to acquire in an ordinary way the knowledge of articulate sounds. It is important to bear in mind that complete deafness is not essential to this peculiarity. Dumbness is frequently met with in children and others where the only cause is *defective* power of hearing.

Treatment.—Whether the outcome of complete or partial deafness, the treatment must be based on the belief that the articulating power is latent, and may be developed by imitating the process of speaking in others, and by a methodical training in lip language. It is most important that sign language should not be cultivated at the same time, and that if a language of signs, whether by the hand or gesture, have been previously taught, it should be thoroughly and at once discarded. With patients

who have full intellectual power, and who are trained as indicated above, it will be found that for them dumbness is a misnomer, articulate sounds, although with a defective modulation, being readily acquired. Individuals coming under this category are erroneously called deaf-mutes.

2. **Dumbness from Central Lesion of the hypoglossal nerve.**—This may arise from cerebral hæmorrhage, tumours, or embolism, and the prognosis is most unfavourable. It is usually associated with other paralytic conditions, but is of all the most persistent.

3. **Dumbness from peripheral lesion of the hypoglossal nerve.**—This is much less frequent as a cause of dumbness than central lesions; nevertheless cases are met with where hydatid or other tumours result in dumbness through pressure on the nerve itself.

4. **Dumbness from Lead Poisoning.**—Among the paralyses arising from the slow effects of imbibition of lead is paralysis of the tongue, with consequent loss of articulating power. This defect is usually associated with grave impairment of other parts.

Treatment.—The treatment of dumbness due to lead-poisoning will be best effected by elimination of the poison by the administration of iodide of potassium, and the judicious employment of galvanism to the spinal system.

5. **Dumbness from congenital defects of the tongue or of the palate.**—Various congenital local lesions are met with giving rise to dumbness.

Treatment.—Many of these cases are remediable by surgical or surgico-dental help, followed by methodical teaching.

6. **Dumbness from emotional lesions.**—Dumbness occasionally arises from great emotional disturbance, such as great anger or sudden fright. Moreover, it is often met with, without such marked cause, in individuals, especially of the female sex, having a highly developed emotional life.

Treatment.—Cases of this kind are usually successfully treated by faradisation about the muscles of the neck; the patient at the same time being encouraged to call his articulating power into action, and in proportion to his success the faradic current being discontinued. The moral treatment here indicated may be greatly assisted by promoting the general health, and placing the patient under the best possible circumstances as to hygiene and moral discipline.

7. **Dumbness from intellectual disorders.**—This is by far the most common cause of true dumbness. It may arise from idiocy or imbecility of a congenital nature; from that which has been acquired early in life; or from dementia as the outcome of acute or chronic brain-disease in middle or advanced life. Among the congenitally feeble-minded, dumbness is a very frequent phenomenon. This arises from the association therewith of deformed mouths and highly-arched palates; from defective power of co-ordination of the muscles of the tongue; and from an inability to transform ideas into word-signs. In the most profound cases there is such an absence of ideas that language of any kind is not required.

Treatment.—The treatment of this kind of dumbness is one which requires great tact, patience, and energy; and the success will be commensurate with these aids.

The physical health of the individual should be carefully attended to, so as to induce, by judicious food, frequent bathing, and warm temperature, the highest amount of nervous energy. The power of co-ordination should be sedulously cultivated by methodical exercises, especially of the hands, leading up to well-devised tongue-gymnastics. He should then be taught monosyllabic sounds, by being shown the object represented by the sound, while he imitates the sound when watching the teacher's lips. Having thus acquired the power of producing the word-sign by imitation purely, he is next taught to repeat it from memory when shown the object only. After nouns have thus been taught, the names of qualities and adverbial expressions should be added, and in this manner articulate speech built up.

Where the feeble-mindedness has been acquired after birth, the dumbness resulting therefrom should be treated in a somewhat similar manner to that having a congenital origin, but the prognosis is not so good.

Still more unfavourable is the forecast of dumbness when the result of dementia.

J. Langdon Down.

DUODENUM, Diseases of.—These may be considered under the heads of—1. *Functional disorder*; and 2. *Organic diseases.*

1. *Functional disorder* of the duodenum is said to produce a form of dyspepsia, characterised by pain in the epigastrium and right hypochondrium two or three hours after meals, vomiting, and the distant effects of ordinary dyspepsia—vertigo, headache, drowsiness, burning sensation in the soles of the feet and palms of the hands, &c. Imperfect chymification which attends ordinary dyspepsia may induce these symptoms by generating products which irritate the duodenum. The *treatment* is mainly that of disordered digestion. The bowels and the diet are to be carefully regulated; and such remedies as alkalies, bismuth, oxide of manganese, prussic acid, or hydrochloric acid, exhibited, according to the special requirements of each case.

2. *Organic diseases.*—These are inflammation; ulceration; and new-growths.

a. **Inflammation.**—Synon.:—Duodenitis; Fr. *Duodénite.*—*Acute* inflammation of the duodenum is usually of a mild catarrhal character. It either forms part of an enteritis, or is an extension downwards of a similar affection of the stomach. The ordinary exciting causes are exposure to cold, and irritating ingesta or acrid bile. Usually the symptoms of slight gastric catarrh—a loaded tongue, anorexia, nausea, vomiting of tenacious mucus—are followed by jaundice. When the duodenum is invaded there is said to be fulness and tenderness of the right hypochondrium. As a rule, however, new symptoms are not set up unless the bile-ducts become obstructed by mucus from extension of the catarrh into them, when jaundice supervenes without pain. The attack usually lasts a week or a fortnight, and, with suitable hygienic and dietetic

treatment, passes safely off; it is, however, sometimes followed by jaundice unusually prolonged, and, even when the bile-ducts are free, by prostration and wasting out of proportion to the mildness of the disease in itself. While catarrhal duodenitis does not present characteristic symptoms, it is, however, usually suggested by painless jaundice following exposure to cold, catarrh of the stomach, and enteritis.

Treatment.—This consists in rest in bed, warmth, liquid diet, counter-irritation by mustard and hot poultices, and effervescing salines.

Chronic inflammation, resulting in thickening of the mucous and submucous tissue, and even adhesion of the duodenum to adjacent organs is usually associated with chronic ulceration, or with cancer of the duodenum, pancreas, liver, or other structures. Contraction of the duodenum produces symptoms of obstruction similar to those arising from stricture of the pylorus.

b. **Ulceration.**—*Perforating ulcer*, similar to that of the stomach, is said to be more frequent in men than in women, and hardly ever to occur during childhood; while it frequently follows severe and extensive burns and scalds. The ulcer, usually found in the upper horizontal portion, when recent has clean-cut edges free from swelling. The wall of the duodenum may be perforated, either without previous adhesion, being followed by the signs of general peritonitis; or with adhesion to adjacent parts, such as the liver, the gall-bladder, the pancreas, the colon, the hepatic artery, or the posterior wall of the abdomen—into which ulceration extends to a variable extent. Cicatrisation may induce stricture of the duodenum or obliteration of the bile-duct. As a rule the symptoms greatly resemble those of perforating ulcer of the stomach; more frequently, however, the disease is latent, and induces very obscure dyspeptic symptoms prior to fatal perforation. Jaundice is not more common than in the similar affection of the stomach. In burns and scalds perforation seldom occurs before the tenth day.

The duodenum may be ulcerated by the action of a gall-stone passing into it directly from the gall-bladder.

c. **New growths.**—The most important of these is scirrhous cancer, which may involve the walls of the duodenum, usually by extension. It tends to produce obstruction, or it may set up chronic duodenitis, or block up the bile-duct, and thus give rise to jaundice.

George Oliver.

DURA MATER, Diseases of. *See* Meninges, Diseases of.

DURATION OF DISEASE, *see* Disease, Duration of.

DYNAMOMETER (δύναμις, power; and μέτρον, a measure).

Description.—The dynamometer is an instrument originally invented by M. Duchenne, of Boulogne, for measuring and accurately recording the strength of the hand-grasp, and also for measuring the traction power capable of being exerted by other groups of muscles. The result is shown by an index, which traverses a semicircular dial bearing a scale graduated so as to enable the observer to record the number of kilogrammes which the applied pressure or traction represents. In practice this instrument has been principally employed for estimating the absolute or comparative force of the hand-grasp; and in view of this restriction, Duchenne's instrument is needlessly complex. It has, moreover, the absolute disadvantage of being a little too broad, and of requiring too much strength on the part of the patient to move the index over the lower figures of the dial. A patient with a small amount of motor power, especially if the hand is small, is often unable to set the index of this dynamometer in motion. A cheaper, simpler, and narrower instrument has, therefore, been devised by English makers, the index of which can be moved by the application of a much smaller amount of power. This consists of a simple elliptical ring of steel, to the inner and anterior face of which is attached a brass semi-circular dial graduated with two rows of figures representing pounds instead of kilogrammes. The compression of the steel ring, by lessening its shorter diameter, moves a metal bar projecting from and sliding in a groove behind the dial, and this by rack-work communicates its movement to the index.

Uses.—The dynamometer is a useful instrument, inasmuch as it enables us accurately to ascertain the relative compressing powers of the two hands in cases of incipient or actually developed hemiplegia, and also to learn in a positive and definite manner, from time to time, the amount of improvement or the reverse which may have taken place. Since the power of the muscles of the fore-arm and hand, like that of other groups of muscles, varies a good deal with the general state of health of the patient, the dynamometer is also capable of yielding valuable information concerning the strength of the patient, even where we have not to do with a case of paralysis. Any instrument which, in the place of fleeting and more or less vague impressions made upon the mind of the practitioner at the time, enables him to make a more accurate record in figures in his note-book, is a clear gain to practical medicine—more especially when its use involves no appreciable loss of time.

H. Charlton Bastian.

DYSÆSTHESIA (δύς, with difficulty, and αἰσθάνομαι, I feel).—A term applied to impairment of any of the senses, but especially to that of touch. *See* Sensation, Disorders of.

DYSCRASIA (δύς, difficult or bad, and κράσις, a mixture). A morbid condition of blood.

This term signifies more than a disposition to disease; it implies the presence of some general disease exerting its pernicious effects upon the blood. Hectic fever, septicæmia, and metastatic inflammations are diseased conditions referable to dyscrasiæ. A person sickening for a fever is the subject of a specific dyscrasia. *See* Blood-Disease.

R. Douglas Powell.

DYSENTERY (δύς, with difficulty, and ἔντερον, an intestine). Synon.: Fr. *Dysenterie*; Ger. *Dysenterie*.

Definition.—A specific febrile disease, charac-

terized by considerable nervous prostration and inflammation of the solitary and tubular glands of the large intestine; sometimes ending in resolution, but frequently terminating in ulceration, occasionally in more or less sloughing or gangrene; always accompanied by tormina and tenesmus, the latter being most marked when the disease is located in the rectum or lower end of the sigmoid flexure; stools at first more or less feculent, later on yielding dysenteric products without much if any feculence, such as blood, mucus, slime, and gelatinoid exudation, or—as in the sloughing or gangrenous forms—like the washings of meat, and possessing a putrid or gangrenous odour, and so-called epithelial, ash-coloured, black, gangrenous, pus-infiltrated or tubular sloughs, chiefly consisting of tough, imperfectly organised exudation.

Ætiology.—In almost all, if not in all, situations where malarious fevers abound, as in the vicinity of the swamps and sluggish rivers of tropical and sub-tropical countries, dysentery prevails in proportion to the intensity and frequency of these fevers. When, on the other hand, intermittents and remittents have been extinguished by improved drainage and the conversion of marsh into cultivated land, it becomes equally unknown. In or near the tropics, Great Britain, Canada, the United States, and in many other parts of the world, its diminution has proceeded *pari passu* with the decrement of malarious fevers. There would, therefore, seem to be some intimate connexion between the causation of dysentery and intermittent and remittent fevers.

Paroxysmal fevers interfere materially with the nutrition and functions of the digestive organs, and with the proper nourishment and constitution of the blood. Violent congestion of the abdominal viscera is one of the special conditions of the different forms of ague. Both the liver and spleen are liable to temporary and repeated engorgement, and so in fact are all the organs which minister to gastric and intestinal digestion. Even where malarious poisoning may never have resulted in any of the various forms of periodic fever, it may impair the power of the organic nerve-centres and the muscular tone of the blood-vessels, thus disturbing the balance of the portal circulation, and leading to more or less permanent repletion or congestion. As the congestion is most embarrassing during digestion, interfering with the appetite, and the capacity for digesting and assimilating food, its repeated and prolonged existence must deteriorate the quality and modify the quantity of such important secretions as the gastric juice, the bile, the pancreatic juice, and those furnished by the follicles of Lieberkühn, and by Brunner's and the solitary glands. Crude alimentary principles are thus assimilated from the intestinal tract. The liver is especially liable to functional derangement from the stagnation and slowing of the portal circulation, and thus it happens that in dysentery hepatic impairment is almost an invariable accompaniment. Such being some of the abnormal conditions produced by the operation of malaria in its active or latent form upon the chylopoietic viscera, it is not surprising that, under the prolonged strain, certain portions of the alimentary mucous membrane should break down. Why the solitary glands of the large intestine should be the special seat of dysentery, whilst the corresponding glands in the small intestine should, with few exceptions, escape, it is, in the present state of our knowledge, impossible to say. The most that can be hazarded is, that the elementary structures of these glands take on morbid action through the operation upon them of a *materies morbi* derived directly from their blood-supply. That this poison exists in the blood may be inferred from the fact that constitutional disturbance invariably precedes and accompanies the earlier stages of acute dysentery.

Unwholesome drinking-water is a fertile proximate and exciting cause of dysenteric disease. Bad and unwholesome food of whatever description, by providing aliment incapable of being perfectly digested, may act in producing the disease. In like manner impure air may, by preventing the proper aëration and depuration of the blood, and by promoting the retention in it of inassimilable material, light up dysenteric inflammation of the solitary glands. The transit of acrid and vitiated bile and other secretions poured into the digestive canal, often operates as an exciting cause, and frequently determines a morbid action which might be otherwise righted by resolution, to advance to ulceration, sloughing, or gangrene. It is thus that many a simple but neglected case, scarcely at first distinguishable from diarrhœa—unless indeed every evacuation is most carefully washed and scrutinised—ends in destruction of large masses of the mucous membrane, and death, from the conjoint effect of exhaustion and shock from the separation of the sloughs. Indigestible articles of diet, which cannot be reduced by the juices of the digestive tract to a condition admitting of ready absorption, may act as local irritants and exciting causes. Not only is this so in the earliest visible stage or that of active congestion, but it becomes much more susceptible of demonstration in the exudative and ulcerative phases of the disease, by the repeated investigation of the subjective and objective indications. Thus the aggravation of the tormina and tenesmus in adults and children is traceable to indiscretion in diet, or to the passage of undigested morsels of food, recognisable in the stools. Sudden vicissitudes of temperature from a high to a low range, or exposure to damp and cold combined, especially when the vital powers are physiologically depressed, by checking the excretory action of the skin and diminishing the cutaneous circulation, augment the portal congestion and excite dysenteric disease. This is probably the reason why, in a large proportion of cases, the onset of the disease is ushered in towards midnight or the early morning. The influence of epidemic states of of the atmosphere in the causation of dysentery, signifies only that it is most prevalent at those seasons when malarious fevers are most abundant. As there is an intimate connexion between the existence of malaria and the prevalence of dysentery, it is not difficult to understand why, both as regards type and seasonal frequency, dysentery should bear a striking relation to the severity and seasonal prevalence of malarious fevers.

Is dysentery a contagious or communicable

disease?—Whilst many of the older physicians held that it might be spread by contagion from person to person, it may be affirmed that the experience of most modern practitioners is altogether opposed to this view. There is no clear and unimpeachable evidence to demonstrate that it is propagated in the same way as typhus or smallpox. It may possibly be communicable, like typhoid fever, through air, water, or food—liquid or solid—charged with material derived from the undisinfected and putrefying products of the disorder. Be this, however, as it may, the complete disinfection or destruction of the alvine evacuations should always be regarded as a sanitary measure of supreme importance.

Anatomical Characters and Pathology.—The dysenteric process generally consists of a specific inflammation of the solitary glands (Parkes, Baly, and others). The *first* visible change is congestion, the vessels surrounding and penetrating the capsules being turgid and engorged with blood. The *second* change is augmentation of their contents from the accumulation of albuminous exudation, and enlargement 'from the size of a millet seed to a small shot' (Baly). The *third* change is, provided the inflammation advances, rupture of some of the capillaries in the interior of these little vascular glands, extravasation of blood, with the area of the ordinary dark point on the free aspect increased. The *fourth* stage is now marked by atrophy and molecular disintegration of the free aspect of the capsular wall, and escape of its morbid gelatinoid blood-tinged contents into the canal of the intestine. This is the rule, but, in very exceptional cases, the capsule may burst through the attached portion, lighting up inflammation in the neighbouring connective tissue and muscular coat. In a large number of instances, the morbid process may stop short, under proper treatment, at any of the first three stages, and repair is then effected by resolution. In many cases the morbid action is cut short after the completion of the fourth stage, without further extension of the disease. The adjoining follicles of Lieberkühn do not, in these cases, necessarily participate, to any great extent, in the diseased process. Under these conditions, when the whole of the exudation has been expelled, the glands regain their tone and functions, and recovery—rapid and complete—ensues. It is not often possible to illustrate these conditions in the post-mortem room; because, when death supervenes from dysentery alone, the ravages committed upon every structure of the mucous membrane are so extensive as to destroy the earlier physical phases of the disease. In some cases, however, which have died from intercurrent affections, the writer has been able to demonstrate the earliest stages successfully to his students, at a period prior to the implication of Lieberkühn's follicles, of which the mucous membrane is in great part composed, and to exhibit to them the gelatinoid exudation, termed by others 'gelatinous mucus,' free from or tinged with blood taken from enlarged and diseased solitary glands (*Indian Annals of Medical Science*, p. 190, No. xxiii., 1868).

When, owing to neglect, to constitutional defect in spite of the most careful therapeutic and hygienic management, or to intensity or quantity of the specific poison, the disease is not cured by resolution, the disintegrating or ulcerative process is developed. The whole of the solitary glands engaged perish. The ulceration involves the neighbouring tubular glands, leading to ulcers varying from the size of a mustard-seed to that of a florin or more, in depth generally extending to the submucous connective tissue, and not infrequently laying bare the circular lamina of the muscular coat, sometimes involving the longitudinal layer and perforating it as well as the peritoneal coat, thus admitting of the extravasation of the contents of the bowel into the peritoneal cavity and lighting up peritonitis, which, if general, is invariably mortal, but which, if local and confined to the close vicinity of the perforating ulcer, is not necessarily so.

The ulcers vary in appearance, size, and shape. They may be mere abrasions without much loss of structure, *minute* though penetrating rather deeply into the submucous connective tissue; *irregular*, *serpentine*, or *rodent*, with here and there portions of the surrounding mucous membrane undermined and patulous; *transverse*, embracing partially, or completely, the entire circular outline of the mucous membrane; *circular*, or *oval*, with regular and even margins; or *tubercular*, involving the whole substance of the mucous membrane, looking as if they had been punched out of it. These ulcers, as generally observed in the post-mortem room, are free from sloughs, and present a pale ashy appearance. Sometimes they are of a vermilion or purple colour, from active or passive congestion. They are often covered with flakes of tenacious lymph or exudation, and this may sometimes be seen spread over the neighbouring mucous membrane. The floors of these ulcers are usually formed by inflamed and thickened submucous areolar tissue; but sometimes this has all been destroyed, and then they are constituted of the muscular coat, thickened and infiltrated by inflammatory products; and when the muscular structure has itself yielded to the ulcerative process, they are made up of congested and swollen peritoneum which, as already stated, occasionally becomes perforated.

When the ulceration proceeds solely by molecular disintegration massive sloughs are not observed. But when, as not uncommonly happens in asthenic, malaria-stricken, tubercular and worn-out constitutions, tissue-death occurs *en masse*, at an early period of the attack, sloughing of the mucous membrane, together with portions of the muscular coats, or gangrene, is to be seen. These sloughs, or gangrenous portions of tissue, may be limited in extent. Some or all of them may be successfully detached during life, and can be identified as they are examined from time to time in the stools. In the post-mortem room they may be found partly detached and lying loose, mixed with the fluid contents of the bowel, or attached more or less firmly, sometimes compact, nodular, ecchymosed, gray or olive-coloured, green or yellow and pus-infiltrated, black, flaky, shreddy, shaggy, flocculent like pieces of teased cotton-wool, or ragged and stringy. In the truly gangrenous dysentery, the mucous and muscular coats are enormously thickened, and large portions are found gangre-

nous, varying in colour from a pale olive to purple or black. These appearances and conditions may be restricted to the cæcum and ascending colon, or to the sigmoid flexure, but sometimes they are co-extensive with the internal structure of the large intestine from the ileo-colic valve to the anus. When the ileo-colic valve becomes destroyed, invagination of the lower end of the ileum into the cæcum sometimes happens, causing intestinal obstruction. Occasionally many inches of the gangrenous mucous membrane, with or without the muscular coat, is either found hanging loose in the lower part of the gut, or in process of being detruded from the anus.

In ordinary acute dysentery, advancing to ulceration or sloughing, repair is, doubtless, accomplished, as a general rule, by granulation and cicatrisation. This process can be readily observed in dysenteric lesions of the mucous membrane of the lower end of the rectum, and in healing of the surgical ulcer within the verge of the anus. The reason why repair is frequently accomplished so slowly is because, owing to the irritation caused by the exalted vermicular contraction of the gut and the passage of flatus, fæces, and other products, it is impossible to command the physiological rest necessary for speedy and substantial granulation and cicatrisation. Unless the destruction of tissue is very great, the contraction due to cicatrisation does not occasion much future inconvenience. But if it embraces a large portion of or the whole circumference of the mucous membrane, the subsequent contraction may produce dangerous narrowing of the calibre of the gut, or stricture of the sigmoid or rectum. The thickening and contraction, especially in the attenuated victims of chronic dysentery, can be identified by physical examination. These constrictions are frequently the mechanical cause of constipation and fæcal accumulations.

There is no valid reason for believing that, in true dysenteric ulceration, the lost tissue is ever actually reproduced. When the ulcers have been small, the contraction following repair is sufficient to bring the follicles of Lieberkühn on all sides into close juxtaposition. And this it is which has given rise to the impression among some pathologists, that the lost tissues have been renewed by a process of development and growth. But whenever the ulcers have been too large to admit of obliteration, microscopical examination shows that they have been bridged over by cicatricial tissue, devoid of solitary and tubular glands and sparingly supplied with blood-vessels and absorbents.

In addition to the above anatomical characters, the mesenteric glands are generally found to be enlarged, and as an accompaniment or sequel, organic disease of the liver or abscess is not infrequently discovered to complicate the disease.

Symptoms.—Every attack of acute dysentery is preceded by disordered digestion and constitutional disturbance, indicated by loss or capriciousness of appetite and furred tongue, constipation alone or alternated with looseness, dryness of skin, occasional chilliness and general malaise, with slight rise of the evening temperature. These signs may be viewed as cotemporaneous with the progress of the morbid action going on in the solitary glands. As the disease advances, there is more marked chilliness, succeeded by distinct feverishness. If the bowels have been confined, they now act spontaneously—expelling, at one or more acts of defæcation, almost the whole of the contents of the large intestine. If they have been loose, with or without aperient medicines, the feculence is not so great in quantity. But in either case, beyond a little mucus, there is not as yet any discoverable dysenteric product in the stools. Prior to this conservative evacuation of the bowels, the febrile excitement sometimes runs high; there is thirst, bad taste in the mouth, flatulency, a variable amount of nervous and muscular debility, griping, an accelerated and irritable pulse, restlessness, disturbed sleep, or actual insomnia. During, and immediately after, each evacuation there is tenesmus or painful straining—most intense in those cases where the disease is located in the descending colon, sigmoid flexure, and rectum. The stools are offensive, but there is nothing at this stage pathognomonic in their odour. If, as frequently happens in private practice, the patient comes under treatment at this period, a small dose of castor oil guarded by laudanum, or a full dose of ipecacuanha, with absolute rest in bed and bland liquid nourishment, is sufficient, in a certain proportion of cases, to put a stop to the morbid action, and to promote cure by resolution in from twenty-four to forty-eight hours.

When, however, the disease persists, the symptoms continue in an aggravated form. The tormina and tenesmus become intensified; the desire to go to stool is more frequent, and to remain on the stool or bed-pan more irresistible and enduring, especially if the disease be concentrated in the sigmoid flexure or rectum. In rectal dysentery, there is dysuria, frequent micturition, and sometimes retention, from spasm due to reflex action, necessitating catheterism. The consumption of solid food—even of the most digestible kind—provokes and aggravates the tormina. The griping and tenesmus are now so intensified in degree, and increased in frequency, that each recurrence of them produces much depression and exhaustion, and a pinched and anxious expression of the countenance, with augmented frequency and weakness of the pulse. There is abdominal tenderness. During the acme of the tormina, the patient experiences difficulty in localising this tenderness. He will then declare that he feels agonising pain over the greater part of the abdomen, with or without the application of pressure. But in the absence of the tormina, careful palpation will enable the practitioner to localise it in those portions of the intestine above the rectum affected by dysenteric inflammation. At this stage the tumefaction of the walls of the gut is seldom great enough to be distinguished through the abdominal parietes. The scanty stools are now characteristic, consisting of mucoid exudation tinged with blood, or bloody mucus or slime from the inflamed tubular glands, with isolated portions of gelatinoid exudation, more or less coloured with blood from inflamed and ruptured solitary glands, and with little or no feculence. These conditions are cotemporaneous with the rupture of the affected solitary glands, and a highly inflamed state of

the adjacent follicles of Lieberkühn, as well as of the subjacent and intervening connective tissue. The muscular tissue, though not yet necessarily inflamed, is nevertheless hyperæsthetic. It is this hyperæsthesia which has more to do with the production of the agonising tormina than the diseased glandular organs implanted in and forming a constituent portion of the mucous membrane. These are the symptoms presented in a goodly number of cases met with in private practice, and in a smaller proportion admitted into hospital. The disease is said to have lasted from two to six or eight days. In uncomplicated cases occurring in tolerably good constitutions, they generally yield, without extension of the mischief, to rest, bland liquid food, and full doses of ipecacuanha.

In cases which have been neglected or aggravated by indiscretions in diet and drink, or by diathetic or other defect of constitution, the dysenteric process passes on to ulceration. If the patient has not been brought under proper therapeutic and hygienic management, the tormina, tenesmus, local tenderness, and hardening of the superimposed abdominal muscles are augmented. The calls to stool are more frequent and painful. The urine is scanty and high-coloured, and is surcharged with lithates and biliary pigment. The stools mainly consist of the foreign products already described, but in greater quantity, are now possessed of a peculiar sickly smell, and yield portions of exudation in masses of greater or smaller size, simulating sloughs, but which, on microscopical examination, are seldom found to afford positive evidence of dead tissue-elements.

Unless the disease bends to treatment, it may terminate in sloughing. This may be restricted or extensive. Death of portions of the mucous membrane is always accompanied by vital depression or well-defined muscular and nervous prostration, cardiac enervation, and an accelerated and feeble pulse. In some cases, tissue-death *en masse* happens at an earlier period, even before the rupture of the solitary glands, and the sloughs can be discovered in the stools in from the eighth to the thirteenth day. The acme of vital prostration is manifested during the detachment of the sloughs, when the exhaustion is often much increased by hæmorrhage. Improvement in the strength, volume, and slowing of the pulse, and in the expression of the countenance, the comparative relief from tormina and tenesmus, cleaning of the tongue, and the substitution of feculence for dysenteric products in the stools, signify, in these cases, the probable cessation or turning-point of the disease. The converse implies that the sloughing is extending, and a succession of sloughs of various kinds, with or without muscular structure, continues to be passed, which, in the process of separation, are accompanied by much bleeding, especially in patients poisoned by malaria or afflicted with the scorbutic or hæmorrhagic diathesis. The abdominal tenderness and hardening of the parietal muscles are marked during the separation of the sloughs. The affected portions of the colon can be felt to be swollen, doughy, and 'puddingy' (Chevers). The skin, in unfavourable cases, becomes clammy, features and eyes shrunken, body emaciated, appetite in abeyance, thirst great and distressing, tongue dry and brown, pulse feeble and running, and stools extremely offensive, bloody, slimy or watery, with varieties of sloughs and exudation. The sensibility becomes so blunted that the stools are passed without much pain—often involuntarily; and the patient eventually dies from sheer exhaustion from the extension of the sloughing, or the end may be accelerated by perforation of the bowel in one or more places, leading to extravasation of some of the contents of the intestine into the peritoneum, and general peritonitis.

Sometimes, from the commencement of an attack, or during the course of acute dysentery, rapid sloughing, passing into gangrene, of large patches of mucous membrane, attended by increasing prostration and soon merging into collapse, forms the chief pathological condition. As this extends until, in many instances, it involves almost the whole of the mucous membrane, submucous tissue, and muscular structure, it is characterised by intensified collapse. The tormina and tenesmus, at first excruciating, suddenly disappear, to the delusive relief of the sufferer. Until the gangrene has spread to a great extent, the stools contain a large quantity of slime, blood, pellicular-looking exudation, and much gelatinoid exudation; but as the living mucous membrane becomes diminished, these products also decrease, and, in their room, we notice a watery product of a dark purple or black colour, resembling the washings of meat, giving off an incomparably offensive and gangrenous odour. To the naked eye, and on washing, these stools seem to be absolutely devoid of feculence. They yield a granular sediment of a black colour—gangrenous *débris* blackened by the combination of sulphur with the iron of disorganised cruorin. The abdomen, at first doughy, becomes tympanitic and free from pain on pressure, and the surface cold and clammy; the countenance resembles the haggard and sunken appearance presented during the algid stage of cholera; the tongue is dry, brown, and fissured; the pulse is thready and rapid; food and medicines are rejected, the dejecta are passed involuntarily, perception is blunted, delirium supervenes; and the patient at last succumbs, worn out and exhausted, in from the sixth to the thirteenth day, according to the range and severity of the disease and the constitutional power of the patient.

Chronic Dysentery.—This is sometimes the result of acute dysentery, in spite of the most appropriate management, in persons poisoned by malaria and weakened by fatty or waxy degeneration of the spleen or liver, or both, and in strumous or scorbutic constitutions. The dyscrasia may be so pronounced that the material exuded is incapable of healing up the ulcers by granulation and cicatrisation. The ulcers are repeatedly disturbed by peristalsis, the passage of flatus, fæces, undigested morsels of solid food and the acrid unutilised secretions of the liver, stomach, and pancreas. Thus they are liable to become irritable from renewed congestion and inflammation. The muscular coat participates in the excitement and becomes infiltrated with exudation, which eventually becomes organised and leads to thickening. The floors and sides

of the ulcers are constituted of unhealthy structure. The difficulty thus experienced in effecting repair is augmented. In other cases the intestine becomes atrophied, attenuated, and transparent. The stools are made up of serous exudation, slime, blood, and sometimes of puriform material, with feculence generally unformed. Almost every stool will be found on washing to contain dysenteric products. The appetite is uncertain; the tongue often clean, shining, and devoid of epithelium; the pulse weak and irritable; and the abdominal tenderness easily localised. Thickening can often be detected. Tormina are always present, and unless the disease be confined to the cæcum or ascending and transverse colon, there is tenesmus. Multiple abscesses of the liver frequently supervene and carry off the patient, or after months or years of suffering he may perish from inanition and exhaustion, or from intercurrent disease.

Complications.—Acute dysentery is frequently complicated by the various forms of malarious fever, typhoid fever, the tubercular or the hæmorrhagic diathesis, purpura, scurvy, hepatic and splenic enlargement, malarious cachexia, or abscess of the liver; and in children by dentition. In every case of dysentery the strictest attention should be paid to existing complications. In patients inhabiting marshy districts, and those following a seafaring life, the gums should be carefully scrutinised and the cutaneous surface examined with a view to ascertain the freedom or otherwise from purpuric or scorbutic taint. The history of the patient should be gone into, in order to make out the probable diathetic proclivities—acquired or hereditary.

Sequelæ.—That abscess of the liver, single or multiple, frequently follows acute and chronic dysentery, is indisputable; but whether as a result of the general condition existing, or of local pyæmic poisoning or embolism originating in the veins within the area of the ulcers, is still an open question. Dysentery sometimes terminates in permanent thickening of the parietes of the gut with eventual contraction or stricture, causing constipation, fæcal accumulation or obstruction. When the seat of stricture can be reached, as in the lower part of the rectum, much relief can be afforded by simple incision and subsequent dilatation by means of bougies. Fissure of the anus, or ulcer within the verge of the anus, is a common sequel. Once diagnosed by examination of the stools and by means of the speculum, it admits of speedy relief by incision and after-surgical management.

Diagnosis.—From diarrhœa, dysentery can be diagnosed by the abdominal tenderness, tormina, tenesmus, and the existence of dysenteric products in the stools. Dr. Edward Goodeve, late Professor of Medicine in the Calcutta Medical College, was the first to carry out the practice of washing the stools in dysentery and diarrhœa. The stools are first examined as they lay in the stool-pan. Water is then added in considerable quantity. After a short interval, to allow the dysenteric products to sink to the bottom, the supernatant fluid is gradually poured off. The washing is repeated until the foreign products remain clean and destitute of much smell. When these products are putrescent, or perhaps in all cases, it is convenient to wash the stools with a solution of carbolic acid or other colourless disinfectant. Dysentery is diagnosed from *fissure or ulcer of the rectum* by the fluid or loose character of the stools, with dysenteric products, and by the absence of ulcer, as determined by examination by means of the anal speculum.

Prognosis.—*Favourable.* The following are to be regarded as favourable features in the prognosis of any given case:—The ordinary uncomplicated form of acute dysentery; early subsidence of the constitutional disturbance; a steady, firm and strong pulse, with diminishing frequency and increasing power; moderate abdominal tenderness; absence of tympanites; a placid and normal expression of countenance; absence of sloughs or putrescent matters in the stools; early subsidence of tormina and tenesmus with the appearance of feculence and the contemporaneous decrease of dysenteric products; return of appetite and power of digesting and assimilating food; and the absence of inflammatory or suppurative mischief in the liver.

Unfavourable.—Unfavourable features, on the contrary, are:—The persistence of an elevated temperature; quick pulse with increasing feebleness; sudden freedom from tormina, tenesmus, and abdominal tenderness, with great vital depression or collapse; doughy thickening of the colon with dulness on percussion where there should be resonance; sudden increase of abdominal tenderness, with hiccup, nausea, vomiting, and great nervous prostration, tympanites, and peritonitic pain with constant hardness and tension of the abdominal muscles; increase of putrescent and gangrenous products in the stools like the washings of decomposing flesh; excessive hæmorrhage from the bowel; bleeding from chapped and fissured lips, gums, and mouth; harsh, dry, black or glazed tongue; delirium; picking at the bed-clothes; scantiness or suppression of urine.

Treatment.—Should an aperient be required in the congestive, exudative, or ulcerative stages of acute dysentery, or in sudden relapses supervening upon chronic forms of the disease, the readiest, simplest, and most painless is a tepid water enema of from two to four pints. After the operation of the enema, or immediately the patient presents himself suffering from any of these dysenteric conditions, in those cases where no preliminary aperient is indicated, a turpentine epithem or mustard plaster should be applied to the epigastrium for twenty minutes. At the same time, from twenty grains to a drachm of ipecacuanha suspended in two drachms of syrup of orange-peel and four drachms of water, or in half an ounce of infusion of camomile, with ten grains of carbonate of soda or bismuth, or simply made up into conveniently sized pills, should be administered, The recumbent posture, with the head lower than usual, should be enforced. Liquids should be resisted as much as possible for an hour or two. Thirst may be quenched by sucking pieces of ice, or, when this cannot be procured, by cold water in teaspoonsful at a time. Nausea will probably occur; perhaps, in some cases, retching and vomiting. But as the vomiting is exceptional, and when it does occur seldom happens before the lapse of an hour after the

exhibition of the drug, the ejected matter usually consists of small quantities of gastric secretion. Should the ipecacuanha be rejected, the dose should be repeated as soon as the stomach has been tranquillised. It will be found beneficial to time the large doses, so as to allow of one being given night and morning so long as their use is considered necessary. The signal for the relinquishment of these doses is freedom from tormina and tenesmus, with the occurrence of refreshing sleep, feculent, bilious, or ipecacuanha stools, and restoration of the primary processes of assimilation. If no great amount of disorganisation of the mucous membrane has taken place, these favourable changes are frequently noticed after the administration of the first or second dose, and even if undoubted ulceration has set in, they are generally discerned on the second or third day, or earlier, In either case the drng should be abandoned, as the disappearance of the tormina and tenesmus and the absence of mucus, blood, and slime from the stools indicate the cessation of dysenteric inflammation, and that the affected portions of the bowel have been placed in the most favourable condition to undergo cure by 'resolution,' if the case has not proceeded to ulceration, or by 'granulation and cicatrisation,' if ulceration or even sloughing has already taken place. Chalk-mixture with hyoscyamus and astringents is now quite sufficient to wind up the cure. In some cases ferruginous and bitter tonics are demanded, to give tone to the digestive organs, and to improve the condition of the blood. Counter-irritation by means of turpentine epithems and mustard plasters to the abdomen, or fomentation, are valuable adjuncts in the management of the disease.

The diet should consist of chicken broth, beef-tea, essences of chicken, mutton, or beef; sago, arrowroot, or tapioca; and small quantities of port wine or brandy. During the active period of the disease all food should be given in a liquid form. The disturbing effect of the ipecacuanha given as above directed is only temporary. Abundance of time is, therefore, available between the large doses for the digestion and assimilation of liquid food. As the stools become more feculent and consistent, solid food in the shape of tender chicken, lamb, and mutton, with biscuit and bread, light sago, rice, or tapioca pudding should be allowed. Potatoes and other vegetables should be avoided until the tone of the digestive system has been fully re-established. When the dysentery is complicated with a purpuric or scorbutic condition of the blood, the administration of the juice of the grape, orange, pomegranate, lime, and bael sherbet are essentially necessary as dietetic rather than therapeutic agents.

Opium by the mouth is seldom required. When swallowed it 'locks up' the secretions of the liver, pancreas, and alimentary mucous membrane, rather favouring than reducing the inflammation of the solitary and tubular glands. These bad effects counterbalance the benefits derived from the sleep, diminution of peristaltic action, and temporary decrease of tormina and tenesmus consequent on narcotism. This explains why the real character of the disease is often completely masked by opium, and why apparent amendment is taking place, whilst destructive ulceration and sloughing of the mucous membrane is rapidly extending. As ipecacuanha speedily brings about all the good without any of the evil effects of opium, this narcotic, in any form, excepting as an enema or suppository to relieve tenesmus, particularly in sigmoidal or rectal dysentery, is not only superfluous but injurious. There is less objection to uniting the ipecacuanha with such remedies as are acknowledged to possess the power of lessening the irritability of the stomach, and of increasing its tolerance of the drug, without interfering with the functional activity of those organs whose secretions we are endeavouring to promote with a view to rectify the disturbed balance of the portal circulation. On the contrary medicines of this order may be beneficially associated with ipecacuanha—such as carbonate of soda, bismuth, chloroform, camphor, and hyoscyamus.

When dysentery occurs in pregnant women, large doses of ipecacuanha are not contra-indicated; because, if the disease be allowed to proceed (which is more likely to happen under the old than the ipecacuanha treatment) abortion or premature labour is almost certain to follow; and when such a complication supervenes, in the later months of gestation, the mortality almost surpasses that of any other disease. When the dysenteric inflammation is summarily put a stop to by the ipecacuanha, abortion or premature labour is prevented. Under the opiate method of management, premature labour is not averted, but, in the majority of cases, occurs at the acmê of the disease, when the sloughs are being thrown off; and the patient succumbs to the conjoint shock to the system. In dysentery complicated with pregnancy opiate enemata to relieve irritation in the rectum are more essential and permissible than under other circumstances.

In the acute dysentery of children ipecacuanha is invaluable. For a child of six months a grain, and for a child of one year two grains, should be given with an equal quantity of carbonate of soda, night and morning, until the tormina, tenesmus, and slimy and bloody stools are replaced by relief from pain and by feculent evacuations. It will not often be necessary to continue the drug beyond two or three days at a time. But it should be recollected that the disease adheres with greater tenacity to children than to adults; and although we observe that ipecacuanha has an immediately beneficial effect in diminishing the blood, mucus, slime and frequent stools, still we find that dysenteric or slimy motions with undigested food continue to pass. In that case the ipecacuanha, combined with chalk, bismuth, carbonate of soda, or aromatic powder, should be repeated, once or twice a day, for a certain period, till healthy evacuations are restored. The gums must be lanced when necessary; turpentine liniment or stupes may be applied to the abdomen; weak chicken-broth or arrowroot should be temporarily substituted for milk; and, above all, food must be given in small quantities at a time, and at regularly stated periods. From the age of one year the dose is regulated by adding one grain for each additional year of age up to eighteen, when the doses indicated for adults should be employed.

In cases where evident malarious taint pervades the system and complicates acute dysentery, disulphate of quinine is indispensably necessary. A scruple of the antiperiodic will be most speedily absorbed if dissolved in water acidulated with sulphuric acid, and the exhibition of this may precede by an hour the first dose of ipecacuanha. Ten-grain doses should be given midway between the large doses of ipecacuanha, or during abatement of febrile excitement, until the feverish symptoms have been subdued. Quinine here is quite as important as ipecacuanha, for, until it has successfully checked the disturbing influence which malarious poisoning exercises upon the capillaries of the portal and general circulatory systems, the good effects which ipecacuanha produces are only temporary and incomplete. The mildest febrile exacerbations of a miasmatic origin re-excite dysenteric action, and thus undo the good effected by the action of the ipecacuanha. Hence, the urgent necessity for removing without delay every vestige of masked or active malarious fever complicating dysentery. No drug enables us to accomplish this object so safely and so quickly as the disulphate of quinine in large doses.

When ipecacuanha fails to preserve the life of the patient, its failure may be generally attributed to—(1) coexistence of abscess of the liver; (2) unchecked malarious poisoning; (3) permanent enlargement of spleen or liver, or both; (4) irretrievable constitutional cachexia; (5) Addison's disease of the supra-renal capsules; (6) morbus Brightii; (7) phthisis or tuberculosis; (8) strumous disease of the mesenteric glands; (9) peritonitis with or without perforation of the gut; or (10) the existence of extensive sloughing or gangrene.

The advantages of the 'Ipecacuanha Treatment' (for the revival of which the profession are indebted to Mr. Scott Docker, of the 2nd battalion of the 7th Royal Fusiliers, stationed at the Mauritius,—*Lancet* of July 31 and August 14, 1858) in the congestive, exudative, and ulcerative stage of almost every form and type of acute dysentery, as well as in the acute attacks supervening upon chronic dysentery, may be briefly stated to consist in (1) its simplicity, (2) its safety, (3) its certainty compared with any other method, (4) the promptitude with which the inflammation is stopped, (5) the rapidity with which repair takes place—(*a*) by resolution or (*b*) by granulation and cicatrization, (6) conservation of the constitutional powers, (7) abbreviation of the period required for convalescence, (8) decrease in the frequency of chronic dysentery, (9) decrease in the frequency of abscess of the liver, (10) diminution of mortality to cases treated—all of which are accomplished, (*a*) without local or general bloodletting, (*b*) without salivation, (*c*) without calomel and irritating purgatives, and (*d*) without opium by the mouth.

Ipecacuanha in large doses may be said to fulfil many important indications. It produces (1) all the benefits that have been ascribed to blood-letting without robbing the system of one drop of blood, (2) all the advantages of mercurial and other purgatives without their irritating action, (3) all the good results of antimonials and sudorifics without any of their uncertainty, (4) all the euthanasia ascribed to opium without masking, if not aggravating, the disease whilst the mischief is silently accumulating within. Thus, we possess in ipecacuanha *a non-spoliative antiphlogistic, a certain chologogue and unirritating purgative, a powerful sudorific, and a harmless sedative* to the heart and the muscular fibres of the intestines.

The objections which have been urged against large doses of ipecacuanha in dysentery are, *first*, its 'depressing influence' kept up by nausea and vomiting; and, *secondly*, that it is liable to set up 'uncontrollable vomiting.'

First, the depressing power, nausea, and vomiting have all been over-estimated. Nausea is only a temporary and evanescent effect. Vomiting is an exceptional occurrence; and even when it does supervene, it seldom lasts long. As much nourishment, therefore, as may be required to support the strength can be allowed in the intervals between the large doses of ipecacuanha. But what contributes more to the conservation of the patient's stamina and to the prevention of depression or asthenia, is the speedy cessation of the dysenteric process accomplished by the drug, followed by refreshing sleep and the power of digesting and assimilating nourishing food. Such remarkable results as these soon reconcile any patient suffering from dysentery to an otherwise disagreeable remedy.

Secondly, when uncontrollable sickness and vomiting succeed the employment of this drug in the manner already recommended, the existence of one or other of the serious conditions previously enumerated may be more than suspected. In the absence of these complications, unmanageable vomiting is seldom if ever witnessed. Hence, in a preponderating majority of the cases of dysentery met with this objection is quite untenable. The truth is that every physician who has used ipecacuanha in heroic doses soon learns that depression of the vital powers from it is not to be feared, and is surprised at the small amount of vomiting that follows its administration, and at the unexpected ease with which the stomach tolerates its presence.

When dysentery becomes *chronic* no time should be lost in counselling removal from a malarious to a non-malarious and mild climate. A sea voyage—provided easily digestible food can be secured—is often attended by the happiest results. To men so afflicted 'the salt ration,' as remarked by Dr. Maclean, 'is simply destruction.' The clothing should be warm, and flannels always worn around the abdomen; Dr. Maclean also recommends 'the use of a water belt over the abdomen for some hours daily. This acts as a fomentation, and the steady uniform pressure it maintains seems to favour the absorption of the fibrine effused between the intestinal coats. If there be much uneasiness about the fundament, a water compress over the anus affords more relief than opiate enemata.' The food should be chiefly concentrated soups, milk and lime-water, and sago, cornflour, arrowroot, &c., egg-flip with port, sherry, or brandy; or, if solid food can be digested, the tenderest chicken, lamb, or mutton, with bread and biscuit, may be allowed. Beyond airing in a carriage or chair, no

exercise should be attempted. The position should generally be recumbent or semi-recumbent. The erect position excites peristaltic action, and thus disturbs the physiological rest required to facilitate the repair of the ulcers. Antiscorbutic juices should be given where there is the least taint of scurvy or purpura. Frequent blistering does much good. All forms of counter-irritation are beneficial.

Gallic acid, acetate of lead, sulphate of copper, nitrate of silver, are reputed to act beneficially. Dr. Maclean's favourite remedy, 'particularly in men returning from tropical regions, anæmic from loss of blood and the depraving influence of malaria, is the solution of the pernitrate of iron. Under this remedy the whole system often rallies wonderfully, the condition of the blood improves, colour returns to the blanched cheek, the stools become more natural and less frequent, the appetite improves, and digestion is more perfectly performed. The citrate of iron and quinine may after a time be substituted.' As nearly all chronic cases are underlain by a malarious taint, quinine should form an important element in the therapeutic management, and the greatest care should be taken to secure for the residence of the patient a climate at once mild and temperate and free from suspicion of malaria. Bathing during convalescence is an efficient and welcome auxiliary. Tepid or warm baths medicated with Tidman's sea-salt or with nitro-muriatic acid act in stimulating the secreting function of the skin. But it will often happen that, in spite of the most careful dietetic, hygienic, and therapeutic management, no substantial progress towards the repair of the ulcers is made, and the patient eventually dies, worn out from suffering and the asthenia consequent literally on inanition.

JOSEPH EWART.

DYSIDROSIS (δύς, with difficulty, and ἱδρώς, sweat).—This is a disorder of the sweat-follicles hitherto confounded with eczema, and first differentiated therefrom and accurately described by the writer. It occurs in winter as well as in summer, and often in those who perspire freely; and it attacks the hands chiefly, and especially the interdigital and the palmar surfaces. The disease is characterised by the development of vesicles, which are not formed in the usual way in the rete, but are distensions of the sweat-apparatus by sweat secreted in excess, and which fails to find its way outward free upon the surface. These sweat-vesicles are at first situated beneath the level of the skin, and indeed appear as little boiled sago-grains imbedded deeply in the substance of the skin, and when once seen are readily recognised again. If pricked a little sweat oozes out. In the earliest stage the reaction of the fluid may be acid, but it soon becomes alkaline from admixture of serosity. These vesicles are distinct the one from the other at first, and are scattered about the interdigital surfaces or the palms, or they may be grouped. In some cases their fluid contents dry away, and a little dryness and perhaps slight degeneration follow. They may enlarge and become prominent upon the surface, or run together into bullæ, and if the sweat-secretion is free, large bullæ may form. Usually the cuticle becomes white and opaque from maceration in the fluid which collects beneath it; and subsequently it peels off in a membranous manner, leaving behind, however, a dry reddened surface, but not a discharging one as in eczema. One or both hands may be affected; and the feet may also be attacked. The disease occurs in connection with nervous debility. It may be attended with much itching or burning pain; and may be accompanied by miliaria.

ANATOMICAL CHARACTERS.—If a portion of skin be excised and examined in the early stage of the disease, it will be observed that there is no true dermic inflammation, but that the morbid changes are limited to the sweat apparatus, as the writer has shown (*Pathological Society's Transactions*, 1879). The sweat-gland-coils are congested, and the results of such congestion are also seen in the duct-walls as they run upward to the Malphigian layer, where the vesicles are formed. In the early condition the sweat-ducts are dilated, and choked by epithelial débris, and gradually this portion and the rete layer immediately outside the ducts, dilate into vesiculations under the pressure of the fluid poured out into the tube. In later stages the effusion is so free, and the distension of the tissues so decided, that the nature of the original formation of the vesicles is not recognised, and the vesicles may simulate those of eczema, save that the amount of inflammatory products is less, and there is no distinct connection between vesicles and engorged papillary vessels beneath. In the earlier stages of the vesicles, however, ducts can be distinctly traced entering the vesicles from above and leaving them from below, which conclusively proves that the vesicles are formed in connection with the sweat-apparatus.

TREATMENT.—This consists, internally in exhibiting diuretics, to be followed by nervine tonics according to circumstances, and locally in the use of soothing and astringent applications.

TILBURY FOX.

DYSMENORRHŒA (δύς, with difficulty; μήν, a month; and ῥέω, I flow).—Difficult and painful menstruation. *See* MENSTRUATION, Disorders of.

DYSOREXIA (δύς, with difficulty, and ὄρεξις, the appetite).—An obsolete term for impaired or depraved appetite. *See* APPETITE, Disorders of.

DYSPEPSIA (δύς, with difficulty, and πέπτω, I concoct).—A synonym for indigestion. *See* DIGESTION, Disorders of.

DYSPHAGIA (δύς, with difficulty, and φάγω, I eat).—Difficulty in swallowing. *See* DEGLUTITION, Disorders of.

DYSPHONIA (δύς, with difficulty, and φωνή, the voice).—Difficulty in producing vocal sounds, so that the voice is more or less enfeebled. *See* VOICE, Affections of.

DYSPNŒA (δύς, with difficulty, and πνέω, I breathe).—Difficulty of breathing. *See* RESPIRATION, Disorders of.

DYSURIA (δύς, with difficulty, and οὐρέω, I pass water).—Difficult or painful micturition. *See* MICTURITION, Disorders of

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EAR, Diseases of.—The natural division of the ear into external, middle, and internal, suggests a rational, as well as a convenient classification of the disorders to which the auditory apparatus is liable.

I. External Ear.—In examination of the external meatus and tympanic membrane, bright diffused daylight, or, when this is not obtainable, light from a bull's-eye lamp lit with gas, is the best for illumination, and the light should be reflected from a concave perforated mirror of eight-inch focus down a tubular speculum. In any operative proceedings the mirror should be worn on the forehead, as in examining the throat, but otherwise should be held in the hand. As great variations in the calibre of the auditory meatus are met with, it is necessary to be provided with specula of several sizes, the most convenient form being that known as Gruber's.

Of the affections of the external ear the most important are the following:—

1. **Eczema.**—Although the acute form of eczema occasionally affects the auricle and external auditory meatus, it is far more common to meet with the chronic variety. Elderly females are especially subject to eczema of the ear, and it is to its long continuance that the remarkable narrowing of the external meatus throughout its whole extent, met with occasionally in the subjects of this complaint, is generally attributable. Such narrowing will often amount to almost complete closure, and it is in these instances that eczema becomes the cause of greatly impaired hearing; for when this condition is arrived at, the passage down to the tympanic membrane is at times so small as only to admit of a very small probe. It is for this reason that, although no special methods of treatment are called for, beyond what is necessary when parts other than the ear are affected with eczema, it is of the greatest importance to keep the meatus sedulously free from secretion, and this occasionally is not a very easy matter.

2. **Changes in cartilage.**—Another condition, in which the external passage becomes subject to partial closure, is shrinking of the cartilaginous part of the meatus. This again, is a complaint of old age, and is attributable to no known cause. It is readily relieved by the patient wearing a piece of silver tube, to keep the passage patent.

3. **Bony growths** in the osseous part of the canal present two entirely distinct phases: one in which, beyond the enlargement of bone, there is no discoverable disease, and no impairment in hearing power; the other where the growth would seem to owe its origin to some irritation.

In the first case, the enlargements are very frequently symmetrical in either ear, and synchronous in their growth. So exactly is this so, that often where they exhibit three curves in one part of the bony canal on one side, the curves will be found to be precisely similar in size and position in the other ear. As the enlargements are not attended with pain, the patient will obviously be quite ignorant of his condition, until his attention is directed to one ear by a slight accumulation of cerumen, which will suffice to obstruct the passage of sound to the tympanum.

In the other example alluded to, disease of the tympanum precedes the so-termed exostosis, and a perforation of the tympanic membrane, attended with a purulent discharge, will be present perhaps for some years before the growth of bone is discovered. It is in such a case that sometimes the exostosis, by preventing the escape of pus, becomes the indirect cause of death due to cerebral abscess. This is especially so where, in addition to the exostosis in the meatus, there is a polypus growing from the tympanic cavity.

Treatment.—With this complication, or where the meatus becomes completely closed, and in these two cases alone, it occasionally becomes imperative to remove the bony growth. The position of the tumours, and their extreme hardness, make this no simple task; and (except in the instance mentioned by the late Mr. Syme, when they were exceptionably friable) their removal has been attended with great difficulty.

Up to the present time two modes of proceeding have been the most successful. The first of these is as follows:—Two needles being inserted into the base of the growth, holes having been drilled for this purpose, the continuous current derived from ten to twenty pairs of plates (Stöhrer's battery) has been passed through them for a few minutes, and in the course of about six weeks the bone thus destroyed has become loose, and is readily removed with forceps. The second method consists in grinding the bone away by means of a drill, now in common use with dentists. Either proceeding is attended with so much pain that an anæsthetic is necessary.

4. **Inflammation.**—The external auditory meatus is subject to inflammation, diffused or circumscribed, the latter occurring in the form of small abscesses or boils. Both affections are attended by acute pain, and in each the general health of the patient has been out of order for some time previous to the local trouble.

Treatment.—Treatment in the direction of improving the general health; and local bleeding by means of leeches applied in front of the tragus, will often rapidly relieve the diffused form of inflammation; but when it has continued for a long period (as it not infrequently does), in addition to the soft tissues the periosteum becomes affected. The passage then throughout its whole extent becomes so swelled as to nearly close the external opening, and pain is constant. The only treatment which gives complete and permanent relief under these circumstances is to make two or three free incisions down to the bone, along the whole extent of the osseous part of the canal. A convenient instrument for this purpose is a small sharp-pointed curved bistoury. As to the propriety of opening

abscesses in this situation there can be no question, for, owing to the extreme denseness of the tissues and their approximation to bone in the external auditory canal, abscess in this part is slow in its progress and attended with very great suffering. These abscesses being especially liable to recur, a proper regimen and medicines appropriate to the failure in general health are required.

5. **Fungi.**—The external auditory meatus has been occasionally found to be the seat of two varieties of vegetable fungus, namely, *Aspergillus flavus* and *nigricans*. The symptoms which they have given rise to have been great irritation, and a slight discharge. They have been readily destroyed by syringing, and the local application of spirits of wine.

6. **Polypus** of the ear is usually preceded by inflammation in the tympanic cavity and perforation of the membrane; and is considered along with diseases of the *middle ear*.

7. **Hæmatoma Auris.** *See* HÆMATOMA AURIS.

II. MIDDLE EAR.—All affections of the middle ear originate in some part of that tract of mucous membrane which, commencing where the Eustachian tube opens into the pharynx, forms the lining of this tube, and of the cavity of the tympanum, finally becoming the innermost layer of the tympanic membrane. To the character of this tissue is due the term catarrh, which, in its two forms of purulent and non-purulent, is used in describing any deviation from health which, directly or indirectly, is the cause of pathological change in the Eustachian tube or tympanum.

1. **Obstruction of the Eustachian Tube.**—One of the most frequent conditions under which the Eustachian tubes become the seat of obstruction is that met with in children or young persons. The subjects of this affection present a very characteristic aspect. They breathe almost entirely through the mouth, which, sleeping or waking, is kept partially open; their tonsils are often enlarged, and they snore loudly during sleep. The mucous membrane of the nares and pharynx is swollen, and secretes in excess; owing to this tumid state of the fauces the passages to the Eustachian tubes in this situation do not admit of the constant necessary supply of air to the tympana. The air in these cavities undergoes partial absorption, and thus becomes more rare than that external to the tympanic membrane; the density of the outer air remaining the same, the equilibrium from pressure is destroyed; the membrane, consequently, is retracted, the chain of ossicles are pressed inwards, and thus the conduction of sound becomes interfered with—in short, the patient is more or less deaf. In these cases inspection of the tympanic membrane at once reveals the state of affairs. As the cavity of the tympanum is not involved in the catarrhal change, its translucency and lustre are not impaired; the handle of the malleus is tilted inwards, the head of this bone is unusually prominent, and there is a distinct fold crossing the upper part of the posterior section of the membrane. Where the obstruction has lasted for a long period, the membrane will appear to be almost fallen in upon the walls of the tympanum, and the promontory and incus may be distinguished. If under these conditions the tympanum be inflated on Politzer's plan,[1] an instant return to good hearing follows, but in the course of a few days the improved hearing partially dies away, leaving the patient, however, in some degree better than before the operation.

TREATMENT.—This should be twofold. In the first place the tympanum should be regularly inflated, and this may be practised at first every three or four days, and gradually at longer intervals. Secondly, astringent applications should be applied to the pharynx. Of these applications one of the best is a solution of perchloride of iron, 2 drachms to 1 ounce of water, and it should be used daily by means of a curved camel's-hair throat-brush. When the nares are much obstructed, great benefit will follow the use of saline solutions through the nasal douche, or they may be insufflated, that is, drawn up through the patient's nose into the pharynx and then spat out.

If the tonsils are so much enlarged as to interfere with the respiration, it will be necessary to remove them; but the reason for this proceeding is not that they press upon the opening of the Eustachian tube, but because their presence keeps up the unhealthy condition of the pharynx.

Under this routine of treatment the patients completely recover their hearing; the space of time during which it is necessary to continue treatment varying according to the obstinacy which each case manifests.

Obstruction of the Eustachian tubes in *adults* presents certain well-marked differences from the affection as it prevails in *children*. An ordinary cold is the beginning of the trouble. It is more usual to find one instead of both tubes obstructed, and more often than not the tympanic cavity is involved in the catarrh. Where this is not the case—and it will be evident from the retained lustre and transparency of the membrane—the same principles of treatment as are pursued in the case of children will hold good, except in so far that the affection in grown-up persons is less persistent after the tube has been once artificially opened; and that, to effect this, Politzer's method is sometimes not sufficient, or, even if so, not as efficacious as the Eustachian catheter. It must also be borne in mind that in the treatment of cases in which one ear is healthy, by means of the catheter the affected ear exclusively may be subjected to the air-douche, whilst with Politzer's method it is impossible to avoid forcing a stream of air into the healthy tympanum, and this is not always an advisable proceeding.

The Eustachian Catheter.—The following is the mode of using the Eustachian catheter:—'Place the patient in a chair, and let him lean back; steady his head with the left hand firmly fixed on the top of it; hold the catheter lightly in the right hand, with the curve downwards

[1] This method of inflating the middle ear (now in such general use) consists in passing a stream of air from an india-rubber bag through one nostril whilst the patient swallows some water. The operator at the same time closes one nostril with the forefinger of the left hand, and completes the closure of the other with the thumb. The mouth must be kept firmly shut.

and pass it quickly in this position through the inferior meatus of the nose to the posterior wall of the pharynx. When this is felt, withdraw the catheter about half an inch, and tilt the point of the curved end rather upwards, and to the left or right, according to the side which is being operated upon. Now hold the catheter and end of the patient's nose steadily between the thumb and the first two fingers of the left hand. All this time the ear of the patient and that of the surgeon are connected with the otoscope. The point of the catheter is now supposed to be in the pharyngeal orifice of the Eustachian tube, but the only certain sign of this being the case is that when air is forced into the catheter it will be heard through the otoscope to impinge upon the tympanic membrane when a stream of air is passed down the catheter.'

The catheter may be made of silver or of vulcanite, but, of whatever material, it must be inflexible whilst being used. Beyond this, suffice it to say here that in practised hands its employment is invaluable, and indispensable in the treatment of most affections of the middle ear, not only in overcoming obstruction of the Eustachian tube, but also as a means by which injection of fluids may be applied to the cavity of the tympanum. In making use of the air-douche an indiarubber bag fitted to the catheter should be employed, and in using injections to the tympanum a similar arrangement is necessary.

2. **Catarrhal Inflammation of the Tympanum.**—When the tympanic cavity has become involved in the catarrhal state, or when the affection, instead of proceeding up the Eustachian tubes, begins in the tympanum, as it frequently does, those changes have commenced which, of all others, form the most frequent impediments to the conduction of sound—in other words, which make the subjects in which they are found more or less deaf; and it may be broadly stated that the extent to which this affection is remediable depends directly upon the time at which the patients suffering from it apply for treatment. In the early stages, the obstruction to the passage of sound through the tympanum is solely due to the effusion of mucus in this situation, and this is easily demonstrated by the moist gurgling sound which inflation of the tympanum produces, as may be heard upon connecting the ears of the patient and surgeon by means of a piece of indiarubber tubing.[1] Afterwards comes what may be termed the dry stage, *i.e.* when the fluid portion of the mucus has suffered absorption, and when any of the products of inflammation may have become more or less organised, or at least in a condition which, if not interfered with, suffers no further change. The morbid conditions which result from non-purulent catarrh of the tympanum are twofold. First, those which affect the tympanic membrane, and are, therefore, demonstrable during life; secondly, those which are met with after death in the tympanic cavity. The first of these include changes in curvature, in colour, and in consistence.

The slighter changes in curvature have been noticed in speaking of obstruction of the Eustachian tube, which condition is necessarily more or less present in all cases where the tympanum has been the seat of catarrh, and these changes are met with indefinitely increased until the state of complete collapse is reached.

In this condition the membrane has the appearance of being in close apposition to the walls of the tympanum, and lapped round the ossicles, so that the forms of the malleus, incus, and sometimes the stapes are distinctly traceable.

In so extreme an example, the membrane is generally bound down to the tympanic wall by adhesions. The first change which the membrane exhibits is a loss of its lustre and transparency; it becomes opaque. Further alterations in colour, in cases of long standing, consist in the formation of patches of brown, yellow (colour of parchment), and white. Variations in consistency will include thickening throughout the membrane, or in parts of it, especially in the cases of dense chalk deposits (phosphate of lime); and thinning in places, so observable sometimes that inflation will induce bladder-like protrusions, which, as inflation is suspended, fall back again: changes in all these respects completely metamorphosing the appearance of the membrane. After death, within the tympanum may be found collections of dried mucus around the ossicles; thickening of the lining membrane; bands of adhesion in all directions; and anchylosis of the ossicles to each other, as well as between the stapes and fenestra ovalis.

As additional evidence during life of obstruction in the tympanum, it may be mentioned that sounds from a vibrating tuning-fork placed on the vertex are intensified when such obstruction exists, and the nerve remains unimpaired: this test is especially valuable where one ear is healthy, inasmuch as the sound will be heard exclusively on the deaf side, this being due to the fact that vibrations of sound thus conveyed to the auditory nerve, on their passage outwards through the tympanum, meet with the obstruction in this position, and are reflected on to the labyrinth. The appearances above described, together with the history of the case, serve sufficiently to distinguish affections of the conducting from those of the nervous apparatus, and the sounds which are produced upon inflation of the tympanum, whether of a moist or dry character, give evidence as to whether the mucus in the cavity of the tympanum is in a more or less fluid state, or has reached the dry stage where the fluid part of the secretion has become absorbed, the more solid portion remaining.

In the first of these conditions, the inflation at once increases the hearing power; in the second, it produces no change in the hearing. An indication in this direction is a most useful guide in respect of treatment, for whatever differences in opinion may exist as to details in relation to this subject, experience has amply shown that the injection of fluids into the tympanum is for the majority of cases the treatment of all others the most successful, and, speaking generally, it may be said that when the sounds which accompany inflation of the tympanum are of a moist character (showing that undue secretion from the mucus membrane is going on), astringents, such as sul-

[1] This tubing should always be used, whether air or fluids are being injected through the Eustachian tube, for upon the sounds thus heard, as well as on the patient's own perception, the answer to the question whether the inflation is complete depends.

phate of zinc, 1 to 2 grains to the ounce of lukewarm water, will be found most efficacious; and that when the dry stage has been arrived at, alkaline solutions—bicarbonate of soda or potash, 5 grains to the ounce, or still better an injection containing hydrochlorate of ammonia, 5 grains to the ounce—should be substituted.

Injecting the Tympanum.—There are three modes of injecting the tympanum, and their order of efficiency stands as follows:—Firstly, when the Eustachian catheter has been placed in position, a few drops of the injection are introduced into it from a small glass syringe, and forced into the tympanum by means of an indiarubber bag, the nozzle of which is made to fit the open end of the catheter. Secondly, a few drops are placed in the inferior naris, on the same side as the ear under treatment, and injected in front of a stream of air blown to the tympanum on Politzer's plan, the patient's head being inclined to the side to be acted upon. Thirdly, the fluid being arranged in precisely the same way, the patient forces it up the Eustachian tube by attempting to blow through the nostrils, whilst the mouth and nose are closed.

The injection may with benefit generally be repeated every other day for from two to four weeks, but for this no rule can be laid down which would apply in every case.

Such is the briefest outline of the treatment under which these cases recover in greater or less degree. The degree of improvement varies within wide limits, but the greater benefits may always unhesitatingly be predicted during the moist stage of the catarrh. Indeed, the necessity for early treatment is abundantly shown, in the instance of catarrhal affection of the middle ear, by the extremely satisfactory termination of cases treated early in the disease, and the slight relief which but too often follows when the affection has been allowed to proceed for years unchecked. In such cases as the latter, the fact that considerable quantities of inspissated mucus have been found in the tympanic cavities first suggested the operation of making an incision into the tympanic membrane, and attempting the removal of mucus through the incision by passing a stream of air through the tympanum. This proceeding, with certain modifications afterwards introduced, is no doubt very useful in cases favourable for its employment, but it should be reserved for those which have defied the less severe means, and where there is unmistakable evidence of an obstruction to the passage of sound through the tympanum. Experiments with the tuning-fork, already referred to, give valuable evidence in this direction; but for a detailed account of this method of treatment, introduced some years ago by Mr. Hinton, the reader is referred to *Questions of Aural Surgery*. Suffice it to say here that an incision about one-eighth of an inch in length is made in the posterior section of the membrane with a cataract-needle, and this is followed by passing a stream of fluid (a weak solution of soda) through the tympanum and Eustachian tube by means of a syringe made to fit the external meatus. In appropriate cases it is often undoubtedly of very great service, and is neither a dangerous nor a harmful proceeding so long as there is no nervous complication; where, however, this is present, surgical interference has at times proved most disastrous.

Another operation, performed by Dr. Weber Leil of Berlin, consists in the division of the tensor tympani muscle, but up to the present time the results at the hands of others do not warrant it as a recognised operation for the relief of conditions inducing deafness.

3. **Purulent Catarrh of the Tympanum.—Perforation.**—The form of tympanitis in which the effused products become purulent, is an acute and generally an extremely painful affection. Usually the pus rapidly makes its escape from the tympanum into the external meatus, by a process of ulceration through the tympanic membrane, leaving as its result a perforation of this structure. In quite the early stage the affection may often be cut short by the free application of leeches in front of the tragus, followed by fomentations, but more often than not the membrane has given way before the patient comes under observation. Even then, if the tympanic cavity be emptied of the pus by the free use of Politzer's inflation and repeated syringing, the opening will often close, and leave very little, indeed sometimes hardly any appreciable deafness. If, however, a purulent discharge through the opening be allowed to go on unheeded for any length of time, it is the exception for the perforation to heal. This condition is constantly seen after scarlet fever, measles, or any of the exanthemata. A perforation of the tympanic membrane presents an infinite variety of aspects, from a small pin-hole to nearly complete loss of the membrane, but there will always be a slight remaining external rim of membrane. This latter is perhaps the most frequent of all forms of perforation, and especially when the ulceration dates from an attack of scarlet fever. Although the handle of the malleus occasionally remains, it more usually comes away in these and other cases where the loss of tissue is very extensive. The head of this bone, however, may always be distinguished, unless there has been complete disorganisation of the tympanic cavity. Among other forms of perforation commonly met with may be mentioned those in which the anterior or posterior half of the membrane is left, and is bounded internally by the handle of the malleus; the so-called *reniform* perforation, where the lower part of the membrane is lost and the umbo of the malleus indicates the position of the hilus of the kidney; and the small, smooth-edged circular perforation which is common alike to all parts of the membrane. Occasionally, though not very often, the tympanic membrane is the seat of a double perforation. Similar variations in hearing accompany this condition, between slight deafness and total loss of hearing power. The size of the perforation affords no guide in this respect, extreme loss of hearing being met with when the perforation is very small, and very slight deafness where the loss of tissue has been most extensive, so that it may be unhesitatingly stated that the loss of the membrane is but in a very small degree the cause of the deafness in these cases, the disorganisation in the tympanic cavity mainly accounting for this. Such disorganisation is at times so com-

plete (especially after scarlet fever) as to include the loss of all the ossicles, total deafness, and paralysis of the muscles supplied by the portio dura. A very small perforation in the anterior and superior part of the membrane may from its position escape notice, but the diagnosis can be always verified by the facility with which air may be made to pass through the opening, or the reverse, provided that the communication between the Eustachian tube and the tympanum is not closed by cicatricial tissue—a very rare condition when so little of the membrane has suffered ulceration.

Treatment.—The treatment of purulent tympanitis and perforation will include assiduous cleanliness; keeping the Eustachian tube free from obstruction; and the use of astringent injections. When the exposed surface of the tympanum is covered, as it sometimes is, with exuberant granulations, much benefit will be derived from the application of solid nitrate of silver to the granular surface, care being taken not to touch any other part. As the condition of the ear improves under these measures, so will the hearing power vastly increase when it has not been completely lost; but there still remains the ofttimes invaluable application of what is spoken of as the *artificial* membrane. Of all kinds, the best undoubtedly is the flattened pad of moistened cotton-wool, applied by the patient, every morning, with a pair of forceps constructed for the purpose. Until this be tried in each case it is impossible to say whether it will do good; but when it is useful—as it is in a large number of cases—by its help the patient will recover very good hearing, and this even when the perforation has existed for a period of many years. That its effects depend upon the support which it gives to the ossicles, thus re-establishing the normal pressure of the stapes upon the fenestra ovalis, has been unquestionably demonstrated.

4. Polypus.—One of the most frequent complications in cases of perforation of the tympanic membrane is polypus, a term employed to designate a fleshy tumour in the ear. Although polypi are occasionally present in the meatus independently of perforation, the most usual situation from which they arise is the lining membrane of the tympanum. Sometimes the exact point of origin is the edge of a perforation, and still more rarely the sides of the meatus. In size these growths vary from a small protrusion through a perforation, to a tumour which entirely fills the meatus and projects externally from the ear. In this latter instance the growth presents a very distinctive appearance, not unlike a raspberry. Sections of aural polypi hardened in chromic acid with few exceptions show the structure to be fibro-cellular, the fibrous element preponderating over the cellular in proportion to the age of the tumour.

Treatment.—In all cases polypi should be removed, and the best instruments for this purpose are the rectangular ring polypus forceps, or, in the case of a large growth, a Wilde's snare. Owing to their remarkable tendency to recur, removal is only the preliminary step in treatment. The principal part of this consists in their complete eradication by caustics. Of these the most efficacious and convenient is chlor-acetic acid, and later in the treatment nitrate of silver. The acid may be applied on a very small camel's-hair brush, or on the point of a probe defended by a small twist of cotton wool, and a convenient form of nitrate of silver is a bulb of the melted salt fused on to a probe or platinum wire. The caustic should be applied daily for some time after the polypus has been removed, and then less frequently. The treatment should also include the same scrupulous cleanliness and application of astringents, so desirable in the case of perforations. It is simply to the want of attention to details that failure in the treatment of aural polypus may be ascribed.

Complications of Tympanic Disease. — *a. Facial Paralysis.*—This is due to inflammation around the portio dura in its passage through the aqueduct of Fallopius. When suppuration in the tympanic cavity, with caries of the bony canal, precedes or accompanies the loss of function in the nerve, recovery is hopeless; but when the paralysis follows a subacute catarrh of the tympanum, not ending in a perforation, as is sometimes the case, the paralysis in time disappears no less certainly than when it is dependent upon an affection of the nerve at a point after its exit from the temporal bone.

b. Pyæmia; Cerebral Abscess; and *Meningitis.* When the mastoid cells become the seat of inflammation, the pain, tenderness, and pitting on pressure over the mastoid process, will at once suggest an early incision down to the bone, and it may be truly said that this is often delayed too long, and perhaps is never done too soon. Again, when the symptoms point definitely to pus within the mastoid cells, the bone should be pierced so as to make the external opening communicate freely with the cells. Relief given in this way will occasionally be the means of saving life, by preventing the absorption of poisoned material into the lateral sinus. Besides pyæmia thus induced, other fatal issues which suppuration in the middle ear frequently entail have their starting point in the tympanic cavity, and in such instances cerebral abscess or meningitis may be the immediate cause of death. In the latter case a post-mortem examination reveals pus in the arachnoid cavity, or between the roof of the tympanum and the dura mater; in the former, the seat of the abscess may be either in the cerebrum or cerebellum; this portion of the brain (the cerebellum) being more generally, though not always, the part affected when the mastoid cells are involved as well as the tympanum.

The pathology of cerebral abscess, as a result of ear-disease, cannot with truth be said in all cases to be completely explainable, and this for the following reason:—Whilst in most cases a distinct communication can be traced between the diseased roof of the tympanum and the sac of the abscess, in a few the most careful examination fails to show any connection between the two, the abscess being separated from the bone by healthy brain-tissue. Occasionally, no disease can be detected in the bone itself, and this even after the bone has been macerated and sections of it made.

Fatal terminations of this nature most frequently occur when cleanliness and local treatment of the ear have been neglected. Hence the necessity for such care.

But the fact that even under the most favourable conditions such events are possible when there is a fistulous opening in the tympanic cavity should induce caution with Insurance offices in taking the lives of persons with this lesion, at the ordinary premiums. Fatal cases of this kind might seem in practice to be almost divisible into two classes, namely, those in which cerebral symptoms come on soon after the establishment of the perforation; and others where there has been a purulent discharge from the ear (that is, from the tympanum) for many years before the advent of such symptoms. In this latter class must be included those cases in which the temporal bone has become the seat of caries; and it may be stated, subject to no exceptions, that whenever exposed bone can be detected by means of examination with a probe within the cavity of the tympanum, the subjects of this condition are always more or less in a perilous state, and that at any time fatal symptoms may commence with a severe rigor, the earliest of all succeeding symptoms. For this reason, even when exposed bone cannot be absolutely demonstrated in the way mentioned, the existence of bone-granulations where there is a perforation of the tympanic membrane should be regarded as a most serious complication. The same danger, though in a very much less degree, may be said to be present when dead bone can be detected in the mastoid process—in a less degree, because the outer table of the bone is often affected whilst the inner remains healthy. The dead bone then in the former position becomes exfoliated, and the external wound heals. Such are briefly the points of importance in connection with caries of the temporal bone. How caries of the mastoid process may be obviated by a timely perforation of the mastoid cells, and how the chief part of the temporal bone may when carious be removed and the patient survive, may be seen on reference to a paper entitled 'Disease of the Mastoid Bone' by the writer of this article in the *Transactions of the Medical and Chirurgical Society* for 1879.

c. Malignant Disease.—In the paper just mentioned is also reported a case of malignant disease of the ear, in which the cavity of the tympanum, having been the seat of suppuration for some time, became affected with epithelial growth, which caused the death of the patient. From all recorded cases of malignant disease of the ear it would seem that the seat of origin of the new-growth will be found to be the lining membrane of the tympanic cavity, and that a purulent discharge from this surface always precedes the appearance of the cancer, and must therefore be regarded as the exciting cause of the growth. In its early stages cancer in this situation bears a strong resemblance to the ordinary forms of polypus. The same cause, then, which in some cases calls into being a polypus may occasionally give rise to malignant disease, and this without any predisposing cause (so far as can be ascertained) in the patient towards cancerous growth.

III. Internal Ear. — Apart from deafness due to local changes in the external or middle ear, the function of hearing is subject to impairment from causes which have their seat in the nervous structures of the ear; in other words, although the conduction of sound may be good, the perception of sound may be faulty. The inability to hear the vibrations of sound conveyed through the cranial bones, such as from a vibrating tuning-fork placed upon the vertex, is indicative of this condition. For the rest, the absence of tympanic disease, and the history of the case, must supply the evidence required for a diagnosis. Familiar examples of this nature are the deafness which often accompanies old age, or which is left after fevers when the middle ear has not suffered; the two forms of syphilitic nervous affection mentioned below; the sudden and sometimes total loss of hearing which occasionally follows severe mental shock; the deafness after loud explosions near the ear, so common in artillery-men and naval men; and that which is caused by blows on the head and boxes on the ear. An attack of mumps will sometimes leave behind an irremediable loss of hearing in one or both ears, unattended with any discoverable change in the tympanum. In a similar way weakly women occasionally become more or less deaf during their confinement, and this symptom becomes aggravated when each successive child is born. In connection with this subject, prolonged suckling may be mentioned as one of the numerous debilitating causes which undoubtedly aggravate the trouble of an already impaired ear.

Among the nervous affections of the auditory apparatus possessing certain characteristics which serve to distinguish it from others is the so-termed Menière's disease, an attack of which at times gives cise to symptoms which would be alarming if their true origin passed unrecognised. A patient who suffers in this way is seized with an attack of vertigo so severe that he not infrequently falls, and for some hours afterwards requires assistance in walking; occasionally vomiting succeeds the giddiness; and he recovers to find himself very deaf in one ear, with which previously he had heard well. Milder attacks of the same nature generally follow the first, and each one leaves the patient more deaf. Although the presumptive evidence is in favour of the theory that the seat of morbid changes in Menière's disease is in the semi-circular canals, up to the present this point has not been quite satisfactorily determined. No treatment appears to exercise any influence upon the disease.

Syphilis.—The affections of the ear due to syphilitic disease demand separate consideration, and they occur under the following varieties:—Firstly, in the form of sores and warts in the external meatus, which yield to local treatment. Secondly, affections of the middle ear during the secondary ulceration of the throat, the treatment for which, beyond specific medicines, in no way differs from what is useful in the ordinary catarrh of the same parts. Thirdly, failure in hearing power during the secondary stages, unattended with any change in the middle ear. This disappears under constitutional remedies. Fourthly, the loss of function in the auditory nerve, so commonly met with in the subjects of inherited syphilis. In these patients the hearing power begins to fail between five and fifteen years of age (very seldom later in life); and proceeds to very great and often total deafness, the period between good hear-

ing and the extreme point of deafness arrived at varying from a few weeks to several years. From this cause children sometimes become in the course of a month or six weeks totally deaf, but such rapidity is exceptional. Experience has shown how powerless treatment is to arrest the progress of this affection, so that attention should be confined to preventing its subjects from becoming dumb, if they are attacked after they have acquired speech and before they are likely to forget it, viz. from about four to seven years of age. This is best attained by teaching them lip-reading, and if they can read, by making them do so (*aloud*) several times each day. In this way a child will retain its recollection of language when otherwise speech would pass away.

W. B. Dalby.

EAUX-BONNES, in France.—Sulphur waters. *See* Mineral Waters.

EAUX-CHAUDES, in France.—Sulphur waters. *See* Mineral Waters.

EBURNATION (*ebur*, ivory).—A state of bone-tissue in which it assumes the whiteness, smoothness, and hardness of ivory, in consequence of an increased deposit of calcareous matter. It occurs chiefly in rheumatoid arthritis. *See* Rheumatoid Arthritis.

ECBOLICS (ἐκβολή, abortion).—This name is given to the measures that produce abortion. In moderate doses ecbolic drugs act as emmenagogues. *See* Emmenagogues.

ECCHYMOSIS (ἐκ, out of, and χυμός, juice).—An extravasation of blood into the cellular tissue, due either to injury or to disease. It presents at first a more or less blue or bluish-black appearance, which changes with age, passing through green to yellow. *See* Extravasation.

ECHINOCOCCUS (ἐχῖνος, a sea-urchin, and κόκκος, a grain).—This term, in its original generic signification, was employed by Rudolphi for the purpose of including several varieties of bladder-worm infesting man and animals (*Echinococcus hominis; E. veterinorum; E. granulosus, &c.*) These different bladder-worms are now collectively spoken of as *hydatids*, and all of them are known to be mere varieties of the common hydatid, which (as proved by the experimental researches first successfully instituted by Von Siebold, and subsequently verified by Haubner, Küchenmeister, Leuckart, Nettleship, and others) forms one of the larval or sexually immature stages of growth of a small tapeworm, normally resident in the intestinal canal of the dog and wolf (*Tænia echinococcus*). From a physiological point of view, a thorough knowledge of the mode of origination and development of the so-called echinococcus becomes most instructive; but a full exposition of the histological and other changes that accompany the metamorphoses cannot be given in this place. Practically, the term echinococcus has at length come to be employed in such a restricted sense as to refer only to the scolices, or *heads* of the future Tæniæ, which are normally developed from the granular layer or internal membrane of the hydatid. Different opinions exist respecting the precise structural changes involved in their formation, but what is already known and accepted by helminthologists is the result chiefly of the labours of Leuckart, Naunyn, Rasmussen, Wilson, and Huxley. The clinical and hygienic bearings of this subject in relation to the so-called echinococcus-disease will be discussed elsewhere. *See* Hydatids.

T. S. Cobbold.

ECHINORHYNCHUS (ἐχῖνος, a sea-urchin, and ῥύγχος, a beak).—A genus of thorn-headed worms, belonging to the order Acanthocephala. Until the year 1857 there does not appear to have been a well-authenticated instance of the occurrence of this form of entozoon in the human body. In that year a young example (*E. hominis*, Lambl), was found, *post mortem*, in the small intestine of a boy, nine years of age, who died of leukæmia (*Prager Vierteljahrschrift*, 1859.) This specimen measured less than a quarter of an inch in length. It has been supposed that the parasite was an immature example of *Ech. gigas*, but this view has been disproved by Leuckart. Whether it be a new and altogether distinct species remains uncertain. The more recent instance alleged by Welch cannot be accepted as genuine, but must be referred to *Pentastoma*.

T. S. Cobbold.

ECLAMPSIA (ἐκλάμπω, I flash, I explode).—This term is now used as a synonym for convulsions, whatever may be their cause. *See* Convulsions.

ECPHYMA (ἐκ, out of, and φῦμα, a swelling). A growth from the integument. The term was employed by Mason Good as a designation for warts and corns, but is at present almost obsolete.

ECSTASY (ἐξίστημι, I amaze).—Definition. The term ecstasy has been applied to certain morbid states of the nervous system, in which the attention is occupied exclusively by one idea, and the cerebral control is in part withdrawn from the lower cerebral and certain reflex functions. These latter centres may be in a condition of inertia, or of insubordinate activity, presenting various disordered phenomena, for the most part motor.

Description.—The subjects of ecstatic phenomena are commonly of the female sex, or are men who lead celibate and ascetic lives. To these individuals they are in the present day almost confined. In the middle ages, on several occasions, under special circumstances, an intense dominant emotion, with some attendant ecstatic manifestations, spread widely by a sort of moral contagion.

Women who are the subjects of this morbid state are usually single, frequently present menstrual irregularities, and often distinct evidences of hysteria, of which the ecstatic condition may be but a part. The immediate cause of the attack is usually some repeated vivid emotion, commonly religious, sometimes one of fear. The direction taken by the motor or other phenomena of the ecstatic state is often very obviously determined by imitation. With this are associated, in some cases, assertions of supposed facts, which transcend the ordinary course of natural phenomena, and which have been proved, in many instances, to depend on intentional fraud.

As forms of ecstasy we have the condition of

religious enthusiasts, who lose, in their one dominant emotion, all control over the other mental processes, and the latter may act in entire subordination to their religious feeling. Dreams and visions are determined by the ecstatic emotion, and add to its intensity. All consciousness of the body may be lost, so that all sensation may seem to be gone for a time; while the corporeal functions, ingestion and egestion, are reduced to a minimum, and a little exaggeration may represent them as in complete abeyance. Hence the 'fasting girls' of various countries, by whom 'stigmata' marks, in the position of the nails employed in crucifixion, are sometimes presented, probably by artificial production, possibly by the influence of the mental state on the processes of nutrition. In some hystero-epileptics a state of ecstasy—of rapt, intense emotion—forms part of the paroxysmal seizures, and then wild muscular spasms replace the tranquil repose of the more volitional ecstatics. Occasionally—when an intense emotion is shared by many persons—insubordinate muscular movements occur, of a rhythmical character, seen in the Jumpers and Shakers of the present day, and more strikingly in some of the dancing religious ceremonies of half-civilised races, and in the dancing epidemics of the middle ages. Such were the original dance of St. Vitus, in which the exciting emotion was religious; and the tarantella, in which the excitant was terror at the supposed consequences of the bite of the tarantula, which the dance was intended to avert.

Treatment.—It is rarely now that ecstatic manifestations have to be treated except as part of pronounced hysteria, and the treatment is that of the hysterical state which underlies the ecstasy. The measure of paramount importance is the substitution of a 'healthy moral atmosphere' for that under which the symptoms have arisen; and the exposure of actual fraud. Occasionally, even now, examples of solitary ecstasy come under observation. In these considerable care and tact are needed. Ecstatics are not amenable to the motives which influence most persons, and if there is actual fraud, will sometimes die rather than be found out. In the case of fasting girls, due observation of the body-weight during a short time will answer as well as, and is much safer than, a long exclusion of food. But the removal of the ecstatic to other surroundings is the most important step for both detection and cure. W. R. Gowers.

ECTHYMA (ἐκθύω, I burn out.)—A pustule or pimple; pathologically occupying a mid-place between a pustule and a furuncle. The so-called tar-acne, the small inflammatory pustules developed around a mother-boil, and the commoner eruptions produced by iodine and bromine, are examples of ecthyma. *See* Skin, Diseases of.

ECTOPIA (ἐκ, out of, and τόπος, a place).—An abnormal protrusion or displacement of a part; for example, *ectopia vesicæ*, protrusion of the bladder. *See* Organs, Displacement of.

ECTOZOA (ἐκτὸς, without, and ζῷον, an animal).—A term employed by some naturalists to embrace all the external parasites. *See* Epizoa.

ECTROPION } (ἐκ, out of, and τρέπω, I
ECTROPIUM } turn).—A condition in which the eyelid becomes everted, so that the conjunctival surface is exposed. *See* Eye and its Appendages, Diseases of.

ECTROTIC (ἐκτιτρώσκω, I miscarry).—A term applied to arresting the course of a morbid process, for example, the development of small-pox. The agent by which the pustule is made to abort, namely, the ectrotic, may in this instance be a point of nitrate of silver. A coating of plaster, and especially substances which will exclude the light, such as mercurial ointment, or an ointment of lampblack, are likewise employed as ectrotics of small-pox.

Erasmus Wilson.

ECZEMA (ἐχζέω, I bubble up).—Synon.: Fr. *Eczéma*; Ger. *Eczem*.

Definition and General Remarks.—Eczema is an inflammation of the skin, remarkable for a multiple series of pathological symptoms, and for extremes in degree of development and duration. It may be taken as the type of inflammation of the integument, and as an illustration of the varied pathological manifestations of the skin. As in other organs, the inflammation may be acute or chronic, may vary in severity and extent, and may occur at every period of life; but the special position and functions of the skin render the progress of eczema always uncertain and slow.

Ætiology.—The proximate cause of eczema is hyperæmia. Every exciting cause giving rise to hyperæmia is capable of producing eczema, and if the tissue of the skin be weak will necessarily be the occasion of that affection. It is in this way that local irritants act on a susceptible skin, so as to produce eczema; such, for example, as heat and moisture, friction, mechanical and chemical stimulants, and obstructed venous circulation. It is in this way that a poultice, a water-dressing, a stimulating lotion, or the action of the sun or of a pungent atmosphere, may be the local cause of eczema. Constitutionally, disturbed nervous function, however induced, by producing disturbance of the circulation and nutrition of the skin, is among the commonest of the causes of eczema. The starting point may be malassimilation occurring at any period of life; malassimilation will act as a disturber of nutrition and circulation of the skin, and those pathological processes known as eczema will be the result. In this manner we may trace back the cause to disordered digestion, painful dentition, painful menstruation, pregnancy and parturition, or nervous shock; and we are led to the conclusion that feeble digestion, assimilation, and nutrition constitute a predisposing cause of general and cutaneous debility, which only requires the interposition of an exciting cause to become an eczema. That eczema is powerfully under the influence of the nervous system is shown by the sudden and sometimes periodical exacerbations of its symptoms, and their subsidence under the influence of agents which soothe and tranquillise the nerves. In the simplest form of expression eczema may be said to be a general as well as a local debility and to be induced and kept up by

every cause which tends to lower the life-force of the organism.

Eczema is specific neither in its nature nor in its cause. Every cause of irritation acting on a frame and on a tissue enfeebled by disordered function is capable of becoming a cause of this affection. It is hereditary only in the sense of the transmission of natural tendencies from parent to offspring, and not by virtue of any special virus or *causa morbi*; and for a similar reason it is non-contagious. Nurses are occasionally affected with eczema from contact with the acrid secretions poured out by the inflamed skin, but the same result would follow in an equal degree from contact under similar circumstances with any other kind of irritant fluid, the two essential factors of eczema being a susceptible skin, natural or artificial, and the presence of an irritant. The warmth, the moisture, and the stimulation of the wash-tub are as active a cause of eczema to a sensitive skin as the most profuse contact with eczematous discharge. And there is no more energetic generator of eczema than the sun's rays when operating on the enfeebled integument of the victims of a city life.

Symptoms and Varieties.—The objective signs of eczema are—redness, slight swelling, papulation, vesiculation, exudation, incrustation, desquamation, thickening, hardening, fission or chapping; and the subjective sensations, burning heat, itching, and pain. The whole of these symptoms are not necessarily present at the same time, but they may all be in existence at once on different parts of the same person, and their separate preponderance is marked by distinguishing names, constituting the so-called varieties of Eczema. Thus, for example, when the prevailing symptom is redness, the case is one of *E. erythematosum*, and may subside with simple desquamation. When the hyperæmia causes congestion of the follicles and their up rising in the form of pimples, the case is termed *E. papulosum*. With the moderate swelling or œdema which always characterises eczema resulting from serous effusion, there is commonly exudation beneath the horny cuticle, giving rise to small vesicles, or *E. vesiculosum*, the typical eczema of Willan; and in a pyogenic constitution these vesicles may be converted into pustules, constituting *E. pustulosum* or *impetiginosum*. When the exudation from the surface is so excessive as to sweep away the cuticle completely, and pour forth from the inflamed skin like a veritable catarrh, the form is termed *E. ichorosum seu madidans*, and, from the depth of colour of the vascular base which supplies the exudation, *E. rubrum*. When the exuded secretion is dry on the inflamed surface in the form of crusts, the case is one of *E. crustaceum*, and is well illustrated by the *crusta lactea* of children. When, in consequence of thickening of the affected integument consequent on interstitial exudation, the cuticle is produced in excessive quantity, and continues to desquamate, the eczema is termed *squamosum*, and is the psoriasis of Willan and Bateman. In a more advanced degree of thickening, accompanied with induration, and in chronic stages of the disease, the skin is apt to crack and break, constituting *E. fissum*, the cracks and chaps being termed *rhagades*. Such a form is not uncommon in the palm of the hand, and constitutes one of the varieties of *psoriasis palmaris*. When, from any cause, a state of permanent hyperæmia is maintained in a part, such as the lower extremities, where it is likewise associated with obstructed venous circulation, the whole of the fibrous and epidermic tissues are apt to become hypertrophied, giving rise to *E. hypertrophicum*.

Besides these, the varieties of eczema due to the predominance of a particular symptom, we recognise dry eczema or *E. siccum*, and moist eczema or *E. humidum*, together with other varieties consequent on locality, such as the scalp, the face, the flexures of the joints, the perineum, and the palms of the hands. We also distinguish, as dependent on severity and duration, acute and chronic eczema, and on period of life, *E. infantile*.

Eczema must be considered as one of the most pruriginous of the affections of the skin; hence its Greek names *psora* and *psoriasis*, the former being applied to its more acute, and the latter to its chronic form. Itching is most severe in the dry forms of the disease, such as the erythematous, the papulous, and the desquamating kinds, and is relieved by the exudative process, whether occurring normally or produced artificially by the action of the nails or envelopment. In the moist forms the suffering assumes the character of pain, tingling, shooting, and aching, the pain being sometimes so severe as to be suggestive of the term *E. neurosum*.

Eczema being an inflammation of the surface-membrane of the exterior of the body, is not unfrequently associated with a similar inflammation of the mucous membrane of the air-passages of the lungs, giving rise to bronchitis; hence the complication of eczema infantile with bronchitis is far from uncommon, and in that respect is frequently derivative, a sudden increase of the cutaneous inflammation relieving the mucous membrane, and *vice versâ*; and this association of bronchitis and eczema is sometimes maintained during the whole lifetime of the individual. Sometimes the eczematous bronchitis subsides into a chronic asthma, and sometimes eczema alternates with hay-asthma. Not unfrequently eczema alternates with gout, rheumatism, or neuralgia, acting as a substitute for those affections and suggesting the commonly received opinion that eczema is a consequence of the gouty diathesis. Another and a common complication of eczema are boils; and, in weakly constitutions lymphadenomatous tumours are met with in the axillæ, and sometimes in the eczematous portions of the skin. The complication of eczema with hæmorrhoids and varicose veins of the lower limbs is a well-recognised fact; in the latter instance the dilated and obstructed veins being not only the exciting cause of the eczema, but leading to hypertrophous enlargement of the integument and cellular structures of the limb—to a state that may fairly be compared with elephantiasis Arabum.

Course, Terminations, and Prognosis.—The prognosis of eczema will be mainly influenced by the cause of the disease and the constitution of the patient; and, although constantly teazing and generally tedious, it has a

natural tendency to cure, and very rarely imperils life. It is chiefly obnoxious through its itching, which is sometimes so great as to produce violent excitement of the nervous system; and prolonged nervous irritation increases the exhaustion of the sufferer. Where the health of the patient is in other respects fairly good the prognosis will be favourable; but where exhaustion of power prevails, where assimilation is seriously disturbed, and where much irritability of the nervous system exists, the prognosis must be correspondingly unfavourable. Thus eczema infantile, even when extensive, is easy of cure if the constitution of the child be moderately good; the same may be said of the eczema which depends on vaccination, dentition, and growth. The eczema of puerperal patients yields without difficulty to a tonic and nutritive regimen. The eczema which is substitutive of dyspepsia, gout, rheumatism, or neuralgia, is especially influenced by the vitality of the constitution, and so also is that which is due to exhausted nerve-power. The neglected eczema of infancy and childhood may be prolonged for a lifetime and eczema is not unfrequently one of the indications of broken health, which may alternate with other manifestations of disorder of internal organs, or may be associated with or follow disease of the kidneys, and so prove fatal. Eczema must, therefore, be regarded as a subjective rather than an objective disease, and, although troublesome and tedious, is generally curable. It may annoy the patient for many months or years, recurring with fresh force from time to time, changing with the seasons, and as a complication of other diseases, contributing secondarily to the destruction of life.

Treatment.—The treatment of eczema must be *constitutional* as well as *local*; in a very few instances of chronic eczema, when all participation with the original cause has ceased, local treatment alone may be sufficient, but such cases are exceptional. Constitutionally it will be needful to promote and regulate the functions of digestion and assimilation, and restore the powers of the system; but as eczema always implies a want of vital power, a conservative treatment must be maintained throughout. Our best regulators of the digestive functions are saline purgatives with bitter infusions, quinine and iron; sometimes nitro-muriatic acid with a bitter infusion, and a mild aperient pill. When these have effected their purpose, we may have recourse to more decided tonics, such as the citrate of quinine and iron, strychnine, cinchona with sulphuric acid; or when assimilative debility prevails, to the citrates of potash and ammonia. Where there is much nervous irritability the bromides of potassium and ammonium are serviceable; and in the gouty diathesis moderate doses of blue pill, colchicum, and diuretics.

It is not until these remedies have performed their share of duty that we should call into use the valuable aid of arsenic, and then arsenic, as a nerve-tonic and an assimilative tonic, may be said to be specific. To effect these purposes it should be given in small doses, *e.g.* two to four minims of liquor arsenicalis or the hydrochloric solution, in combination with wine of iron or tincture of cinchona. In some instances the perchloride of mercury with bark has also proved advantageous. Alkalies, as a rule, are objectionable, and if found necessary for a while, should be discontinued as soon as they produce a debilitating influence on the vital powers. In some few instances, where nervous irritability is the prevailing diathesis, arsenic may be adopted from the beginning of the treatment, and infants in general require no preparation for its use.

The *local* treatment of eczema should be alleviative in the acute forms and stages of the affection, and stimulant in its chronic forms. First amongst the soothing remedies is the benzoated oxide of zinc ointment; whilst the stimulants are represented by the mercurial ointments, alkaline ointments, and tar. The oxide of zinc ointment is especially intended to form a thin coating of protection to the inflamed skin, and therefore, where it cannot be secured by a bandage will require to be repeated several times a day; for a like reason, and to prevent the removal of the artificial covering so produced, washing of the diseased skin should be carefully prohibited.

In the earliest stages of the eruption great comfort may be afforded by dusting the eruption with starch powder, or starch powder with the oxide of zinc, or simply with fuller's earth; and zinc powder suspended in lime water forms a very useful lotion for protecting the eruption from the atmosphere at all stages of its progress. This latter application is also serviceable in relieving the distressing pruritus which always accompanies eczema. However, the most important of the remedies for the relief of itching are the preparations of tar, and especially a tar lotion composed of soft soap, tar, and alcohol, more or less diluted, and sometimes combined with hydrocyanic acid.

Where eczema is accompanied with much infiltration and œdema of the integument, especially occurring in the extremities, a process of sweating the limb by means of water-dressing and a waterproof envelope has been adopted with considerable success. And a modification of this treatment by the use of the envelope at night, and the zinc ointment during the day, may be very conveniently adopted in cases where the patient is unable to keep his bed, and is called upon to pursue his daily avocations in life during the continuance of the treatment.

In very chronic cases, again, where there is considerable hardness and condensation of the skin, it may be necessary to apply a blister over the part, and afterwards dress the blistered surface with zinc ointment; or, a milder course consists in the application of a strong alkaline solution or soap. Erasmus Wilson

ECZEMA Marginatum. *See* Tinea.

EFFUSION (*e*, out, and *fundo*, I pour).—The escape of a fluid from its natural channel or cavity into the substance of organs or the cellular tissue, or from free surfaces. As examples, may be mentioned dropsy in its various forms, and effusions resulting from inflammation.

EGYPT, UPPER.—A very dry, tonic,

winter-climate. Mean winter temperature, 62°. Season, October to March. *See* CLIMATE, Treatment of Disease by.

ELECTRICITY.—The purposes for which electricity is employed in medicine are various. It is used as a stimulant to excite muscular and nervous tissue which is the seat of paralysis or pain, and as a stimulant to the tissues generally; its chemical action may be employed for dissolving tissues and coagulating blood within aneurismal sacs; and its thermal effects are employed in surgery for heating cauteries. Electricity is used in its three forms of (1) *Franklinic, Static,* or *Frictional* electricity; (2) *Faradism* (*i.e.* electricity generated by induction, whether voltaic or magnetic); and (3) *Galvanism* or Voltaism, which owes its existence to chemical action.

APPARATUS.—*Franklinic electricity,* which is generated by the friction of glass discs or cylinders, and which was formerly much in vogue, has now become nearly obsolete in therapeutics, and need not detain us in an article like the present.

Faradic batteries should consist of (1) a coil of insulated copper wire, the ends of which are in connection with the plates of a galvanic cell. This is called the *primary coil,* and contains a bundle of soft iron wire in its interior. 2. A second coil of insulated copper wire made of finer wire and containing a greater number of spirals than the primary, which is made to slide over the primary; this is called the *secondary coil.* 3. An *interrupter,* capable of interrupting the current automatically and with great rapidity by means of the constantly recurring magnetic action of the bundle of iron wires in the interior of the primary coil. These batteries should have means of graduating the intensity of the current of either coil, and of including the patient in the circuit of either coil without altering the connections of the conducting wires. Sometimes the galvanic element is replaced by a large magnet, as in the well-known rotating magneto-induction apparatus.

Galvanic batteries when used for therapeutic or electrolytic purposes should be composed of (1) a large number of small cells of low electromotive force, and as constant in their action as possible. The cells known as the 'Leclanche' are the best. (2) Means of including in the circuit any number of cells at will, so that thereby the intensity of the current may be regulated. (3) Means of opening or closing the circuit at will and of reversing the direction of the current without altering the position of the current-carriers (rheophores) on the patient's body. This is effected by means of a simple contrivance known as a *key and commutator.*

Batteries which are required for heating wires and cauteries must be composed of cells of high electromotive force and as large as is practically possible. The number of cells or elements is of less importance than their size. It is not unusual to have, for this purpose, Groves' or Bunsen's cells capable of containing a pint of liquid each.

The essential and distinctive differences of the two forms of current (galvanic and faradic) are the following:—

The Galvanic Current is (1) *continuously evolved* (hence it is spoken of frequently as the 'continuous current'). (2) It *flows always in the same direction, i.e. from* the positive pole (which is in connection with the copper or receiving plate) *to* the negative pole (which is in connection with the zinc or generating plate). This fact must be constantly borne in mind, because the action of the two poles is markedly different, and it has been asserted (on very doubtful evidence, however) that the direction of the current in the body, whether towards the nerve-centres or towards the periphery, has an important effect upon the physiological and therapeutical results. (3) It has well-marked *chemical* and *thermal effects.* This action is most marked at the negative pole, with which if a moderately intense current be used, heat, redness, inflammation, and even sloughing of the skin may be readily produced. It is, therefore, always necessary to frequently change the position of the negative pole on the body. (4) It has *electrolytic* effects. When a galvanic current is passed through a conducting compound liquid, decomposition of the liquid results, oxygen (if water only be used) and acids (if saline solutions be used) being evolved at the positive pole, while hydrogen or alkalies, as the case may be, are evolved at the negative pole. Since the human body consists of a mass of cells which contain and are bathed in saline fluids, many of the phenomena observed on passing galvanic currents through the human body, or any part of it, are probably due to this electrolytic action. Faraday called the positive pole the *anode,* and the negative pole the *cathode,* and these terms are frequently employed.

Induced Current.—With regard to the induced current, the following points must be remembered. (1) It is *momentary* in *duration.* (2) Its *direction is constantly changing,* so that in using it it is less necessary to distinguish between the poles. (3) Its *chemical, thermal, and electrolytic effects* are *nil.* (4) It has much greater '*tension*' than the galvanic current, that is, it overcomes the resistance of the body with far greater ease. (5) It *causes the contraction of healthy muscle* far more readily than the galvanic current. Muscular contractions only occur at the moment of making or breaking a current, and it is mainly to the rapid interruptions of the induced current that its high stimulating power is due. The current of the secondary coil has greater tension, more penetrating power, and greater stimulating power than the current of the primary coil or 'extra-current.' This is due to its being composed of finer wire and having a greater number of turns.

The stimulating effects of the galvanic current which cause muscular contraction, occur only at the moment of making or breaking the current and not during its continuance, and the stimulating effect of the two poles is different, as may be demonstrated by the 'Polar method of investigation,' instituted by Brenner, of St. Petersburg. If one rheophore be placed on an indifferent part of the body, as the back, and the other be placed over a nerve-trunk or muscle, we are able by means of the commutator and key to study the action of either pole on nerves and muscles during the making and

breaking of the current. With weak currents it is found that contraction ensues only when the stimulating rheophore is negative (cathode), and only on closing the circuit. This is called Cathodal Closure Contraction (C.C.C.). If the strength of the current be slightly increased we get contraction also when the stimulating rheophore is positive (anode), and the circuit is opened (A.O.C.). Next follows Anodal Closure Contraction (A.C.C.), but Cathodal Opening Contractions (C.O.C.) never occur in healthy muscles with any currents short of those of unbearable intensity.

The galvanic current, unlike the induced current, affects the nerves of special sense. If applied in the neighbourhood of the eyes, flashes of light are seen, and blindness has resulted in one case from the incautious application of strong currents to the face. The gustatory nerve is affected in a similar way, and the 'galvanic taste' is perceived when the rheophores are placed on the cheek. The taste is acid with the positive, but metallic and coppery with the negative pole. If the rheophores are held to the ear rumbling noises are produced, and it is said that stimulation of the olfactory nerve will give rise to a peculiar smell.

Onimus has pointed out a further distinction between the induced and the galvanic current. 'An induced current,' he says, 'only acts during the infinitely short time of its passage, after which everything returns to order. . . . It can never be anything else but a series of slight excitements. With constant currents real excitement is determined only at the times of making and breaking. . . . It is during the silent period, however, that the principal action of the continuous current makes itself felt.'

It is certain that the rapid interruptions of the induced current and the strong muscular contractions caused thereby, are capable, if the current be moderately strong, of rapidly and completely exhausting the irritability of a muscle, and, if this fact be not constantly borne in mind, harm instead of good will result from the application of faradism. The galvanic current, on the contrary, possesses remarkable refreshing effects, a fact which has been demonstrated by Heidenhain on frogs, and by the writer on the human subject. It is found that a man can sustain a weight at arm's length far longer than he otherwise could, if a galvanic current be passed through the nerves of the limb. The feeling of fatigue can be removed by the application of the current, and the force of muscular contraction is increased thereby. These facts have important therapeutic bearings.

Modes of Application.—To apply electricity we need to have conducting wires and rheophores or current-carriers attached to the battery. The best conductors are made of ordinary telegraph wire, which should be as thick as is compatible with pliability. Telegraph wire is not damaged by moisture and can be readily connected to all forms of batteries and rheophores, and is therefore economical as well as convenient. Rheophores vary much in design. They should all have insulating handles, and the junction between the conductor and rheophore should be about the middle of its length, so that both conductors may be held in one hand without risk of the metallic junctions coming in contact. The most generally useful rheophore is the sponge-holder. An excellent sponge-holder, which retains the sponge with absolute firmness, has been made for the writer by Messrs. Weiss, from a design by Kidder of New York. Rheophores should be of different sizes, from a sponge as big as half-a-crown to the pointed extremity of an olive-shaped conductor. They should be made of metal and not carbon, because the latter is too brittle. They may be obtained in the form of discs, balls, points; and of endless design for reaching particular organs and regions, as the eye, ear, larynx, bladder, rectum, and uterus. They are usually covered with wash-leather, and used moist. A wire brush is useful for influencing the skin. The dry hand of the operator, who allows the current to pass through his own body to that of the patient, may be used for the same purpose. It is often convenient to fix one rheophore to the patient's body, which may be accomplished by placing an ordinary sponge on the surface of the body, laying thereupon the naked end of the conducting wire, and securing the whole with one turn of a bandage. If we wish to influence the surface only, we may use one rheophore dry; but if we wish to affect deeper-lying structures we must overcome the resistance of the epidermis by thoroughly moistening it with hot salt-and-water. We may use one rheophore dry, and one moist; or we may use as a rheophore a porcelain or gutta-percha vessel containing water, into which the limb is placed.

There are two methods of applying electricity, known as *general electrisation* and *localised electrisation*. By the former method we pass the current through the entire body or great part of it; it has been employed for many diseases, but its utility is doubtful. By the latter method, which we owe to Duchenne, we seek to influence special nerves, muscles, or organs, and to limit the action of the current strictly to these parts. If we wish to influence a muscle we may do so either by applying the rheophores directly over the fibres of a muscle (both the rheophores being held in one hand and 'promenaded' over the whole surface of the muscle). This is the direct method, and is the method advocated by Duchenne. Or, instead of trying to influence the muscle itself, we may stimulate the nerve supplying it, and so cause the muscle to contract. This is the indirect method, advocated by Ziemssen. It is effected by using two rheophores of different sizes. A large rheophore is affixed to an indifferent part of the body, while with a small pointed rheophore an endeavour is made to touch the exact point where the nerve we seek to influence is most superficial. Neither of these methods is to be exclusively adhered to. Certain deep-lying muscles, such as the diaphragm and the supinator brevis, are only capable of indirect stimulation. It will be found also that, in certain diseased conditions, muscles will not respond to stimulation through the nerves, but only to the direct application of the current. When we wish to use the refreshing effects of the current, as in cases of paralysis which are on the road to recovery, or in cases of

fatigued muscles, &c., it is advisable to combine the application of the galvanic current with a rhythmical exercise of the affected muscles. Benedict lays it down as a rule that the *locus morbi*, be it brain, spinal cord, nerve, or muscle, should always be included between the rheophores.

Diagnostic and Therapeutical Uses. — **1. Diagnostic Uses of Electricity.**—For purposes of diagnosis, electricity is of undoubted service, since by its means we are often enabled to distinguish between paralysis due to central lesion and paralysis due to peripheral lesion. We are accustomed to speak of a paralysis as 'central' so long as that portion of a nerve-centre is sound from which the nerves supplying the paralysed muscles take origin. Thus in cases of damage to one corpus striatum, the spinal cord and the greater part of the brain being healthy, we speak of the case as one of central paralysis. In cases, too, of paraplegia from local injury, the cord below the injury being healthy (notwithstanding that all mental control is cut off) we speak of the paralysis as central. In such cases of central paralysis we find (*a*) that reflex stimulation of the muscles is possible, (*b*) that the muscles undergo but little wasting, and (*c*) that the irritability of the muscles to faradism is scarcely diminished. We speak of paralysis as due to a peripheral lesion whenever the paralysed muscles are cut off from communication with their nerve-centres, or directly communicate with centres whose physiological activity has been destroyed by disease. In such cases we find (*a*) that reflex stimulation of the paralysed muscles is no longer possible, (*b*) that the paralysed muscles waste with remarkable rapidity, and (*c*) that the irritability of the muscles to faradism is rapidly diminished, and is generally ultimately destroyed. To establish the fact of diminished irritability to faradism is generally not difficult, and in cases of paralysis affecting one side of the body only it is done by comparing the paralysed muscles with their healthy fellows. We must take care that the current does not vary in intensity, and that it passes through exactly similar lengths of the body for the stimulation of both sets of muscles. It will be found convenient to fasten one rheophore to the middle line of the body (a big sponge tied to the back of the neck answers well), and then when the patient's limbs are arranged exactly symmetrically, test the healthy muscles first with a small or pointed rheophore and determine the current of least intensity which will cause contraction. Then the rheophore is to be applied to exactly the same spot on the opposite limb, and, if contraction follows as readily as on the healthy side, we know that there is no diminution of irritability. If, however, contraction do not follow, we increase the strength of current, and so determine to what extent the irritability is diminished, and whether or no it is completely extinguished. We should add that in cases of peripheral paralysis the diminution and extinction of irritability does not supervene immediately on the occurrence of the paralysing lesion, but only after the lapse of a week or ten days. In cases of paraplegia or other cases in which paralysis affects both sides of the body it is, of course, impossible to compare a paralysed muscle with its healthy fellow, and in such cases we can only judge of the amount of irritability by experience and mental comparison with previous cases. It is found, in cases of peripheral paralysis, that after complete extinction of faradic irritability the muscles will respond to a slowly interrupted galvanic current, and that not unfrequently the irritability of the muscles to galvanism is greater on the paralysed than on the sound side of the body. It is said by some German writers that not merely quantitative but qualitative changes take place in the irritability of these muscles and that the Anodal Closure Contraction (A.C.C.) soon becomes very marked, and equals or even surpasses in force the Cathodal Closure Contraction (C.C.C.); and further that the Cathodal Opening Contraction soon becomes more marked than the Anodal Opening Contraction. These reactions, which are supposed to depend upon degenerative changes in the muscle, have been spoken of as the *degenerative reactions*. These quantitative and qualitative changes in irritability are found (1) in some forms of paraplegia due to degenerative changes in the cord; (2) in so-called spinal paralysis both of infants and adults; (3) in traumatic paralysis due to injury of the nerve-trunks; (4) in rheumatic paralysis, that is, paralysis due to 'rheumatic' thickenings of the neurilemma; and (5) in lead-paralysis.

In ordinary hemiplegia the irritability of the muscles remains, as a rule, unchanged. In some cases, however, the irritability is increased in the early stages; and occasionally after the paralysis has lasted some time we find slight diminution of irritability. In the disease known as Progressive Muscular Atrophy, the irritability of the wasted muscles to faradism remains undiminished to the end.

2. Therapeutical Uses of Electricity.—*a. In Paralysis.*—The treatment of paralysis by means of electricity must be conducted rationally and with discrimination. By means of electricity we may attempt to remove the cause of the paralysis by influencing the nutrition of the parts where such cause is situated, by acting on the sympathetic nerve-branches supplying the blood-vessels of the part. Thus it is asserted that the absorption of a clot in the brain may be hastened, and that the nutrition of a damaged brain may be improved, by acting upon the cervical sympathetic nerve. To influence the cervical sympathetic we place one rheophore over the superior cervical ganglion (which may be reached by pressing inwards behind the angle of the jaw), and the other on the back, over the first and second cervical vertebræ. The use of such a proceeding is more than doubtful, and in case of any improvement occurring it would be impossible to know to what such improvement ought to be attributed, since the passage of a current across the upper part of the neck must influence many important nerves besides the sympathetic. On the whole, we think that galvanisation of the sympathetic is not to be advised in the early stages of paralysis. Galvanisation of the sympathetic has been employed in chronic degenerative changes in the brain or cord, but with very doubtful success.

The localised application of the electric cur-

rent to the paralysed muscles is of undoubted service, and in employing it we should bear in mind the following rules. 1. As to the object of our treatment we should remember the words of Sir T. Watson, 'That our aim is to preserve the muscular part of the locomotive apparatus in a state of health and readiness, until peradventure that portion of the brain from which volition proceeds having recovered its function, or the road by which its messages travel having been repaired, the influence of the will shall again reach and reanimate the palsied limbs.' 2. Always to employ that form of current to which the muscles most readily respond. Thus if the muscles act readily to faradism, then faradism is to be used. In some cases of peripheral palsy we find that contraction follows only on the application of a very strong galvanic current, very slowly interrupted, and accordingly a slowly interrupted galvanic current must be used. As the case improves we shall find that a weaker current produces similar results, and that the muscle contracts with moderately rapid interruptions. And so will improvement gradually take place in favourable cases till faradic irritability and lastly voluntary power are restored. 3. Always to employ the weakest currents which will cause muscular contraction, and never to run the risk of exhausting a muscle by causing a too prolonged contraction. Each muscle should be taken in turn, and be made to contract two or three times in succession, and having gone over the whole of the paralysed muscles seriatim the process may be repeated. An application of this kind every other day is usually sufficient. 4. If the paralysis to the will remain absolute, and if the contractility of the muscles be perfect, we do no good by persevering with electrical treatment. This condition is often met with in hemiplegia. The patient is absolutely helpless on one side, although the paralysed muscles are in no degree wasted, and their irritability remains normal. 5. If the paralysis to the will remain absolute, and if the irritability of the muscles be diminished, then electricity is useful, in so far as it helps to improve the nutrition of the muscles and restore their normal degree of irritability. The normal degree of irritability and nutrition being restored (the paralysis to the will remaining absolute) electrical treatment may be discontinued. 6. If the irritability to both forms of current has completely disappeared, we are not justified in persevering too long, nor in holding out delusive hopes to the patient. Nevertheless, treatment should not be abandoned without a patient trial. [For the treatment of special forms of paralysis by electricity, the reader is referred to the appropriate sections of this work.]

β. *In Painful Affections.*—The power of electricity to relieve pain is very great. The relief is usually temporary, but in many cases is permanent. Electricity may act by serving to divert the mind from troubles real or fancied, or its counter-irritating effects may serve the same purpose as other counter-irritants whose power to relieve pain is well recognised. Occasionally electricity will give relief when every known remedy has failed, and in such cases we must suppose that it acts by bringing about some change in the nerves themselves by its specific action on nervous tissue. All three forms of electricity are employed for the relief of pain, but the galvanic current will be found the most generally applicable. Some writers insist that the anode (positive pole) shall be applied to the painful spot. Strong faradisation serves in some cases to give relief. The effects of galvanism should be tried in every case of neuralgia, but it is not capable of relieving all cases, and disappointment is not unfrequent. Where muscular movements increase the neuralgic pains, a rhythmical exercise of the affected muscles should be conjoined with the galvanism. Headache of all kinds not unfrequently yields to electricity; lumbago, sciatica, and those painful muscular conditions which we call 'rheumatic,' are quickly relieved by it. Tinnitus aurium will sometimes yield to the galvanic current when all other remedies have failed.

γ. *In Spasmodic Diseases.*—In the treatment of spasmodic diseases, electricity is of limited utility. Some forms of tremor are relieved by it. Some aggravated cases of writer's cramp have yielded to it when all other remedies have failed, and a few cases of clonic torticollis have received undoubted benefit by its judicious application. Tonic spasm of internal organs, such as the bowel and bladder, has been relieved by the galvanic current.

δ. *In other diseases.*—In addition to the treatment of diseases of a purely nervous character, electricity has been employed as a remedial agent in diseases whose origin is not so obviously connected with the nervous system. It has relieved the paroxysms of angina pectoris, and the burning pains which accompany herpes zoster. It has been employed in the treatment of many obstinate skin-diseases by American physicians, and Dr. Cheadle has recorded a case in which the dilated vessels in a case of acne rosacea were made to contract by faradisation. Rheumatic gout is said to have been benefited by a 'central' application of galvanism (one pole to the nucha, and the other to the epigastrium). The flow of urine in diabetes has been stated to be diminished by a similar process; and the symptoms of exophthalmic goitre have (it is said) been diminished by galvanisation of the cervical sympathetic. There is in fact scarcely a disease, from epilepsy to chilblains, in which it has not been alleged that electricity has been of use. In obstetric medicine, for the arrest of post-partum hæmorrhage, faradisation is now one of the recognised means to be employed; and it has been of more doubtful service for the rectification of displacements of the uterus. Ovarian pain and tenderness have been relieved by the galvanic current, and amenorrhœa has often yielded to electricity.

ε. *Galvano-cautery and Galvano-puncture.*—The chemical and thermal effects of galvanism are largely employed both in surgery and medicine. Its thermal effect has been used for the heating of cauteries; and cauteries so heated have very obvious advantages over all other forms. The chemical effect of the negative pole has been used as a caustic for the destruction of tissues, and tumours of considerable size have, it is said, been 'dispersed' by this means.

Galvano-puncture has been used in the treatment of hydatid cysts of the liver, but it is at least doubtful whether simple puncture is not quite as serviceable. Galvano-puncture seems likely to take a recognised position among the means at our disposal for the treatment of aortic aneurisms. Several cases have been recorded in which improvement has followed this method of treatment, and it seems possible that the operation may be accomplished without danger and almost without discomfort to the patient. The current employed should be generated by a number of small cells of low electromotive power (Smee's cells as modified by Foveaux seem the best). Each pole should terminate in a fine steel needle, carefully insulated except at the point. Both these needles should be passed completely into the aneurismal sac, care being taken that the points of the needles are free in the sac, and that they do not touch, but are separated by an interval of an inch or inch and a half. When the current passes, the whole of its effect will be exerted on the blood within the sac; and, owing to the insulation of the needles, the coverings of the sac will receive no damage. The effect of the current is to cause a firm coagulum to form round the positive pole, while the liberation of gas at the negative pole causes there a frothy soft coagulum. As a rule the gas generated is swept onwards by the blood-current and causes no trouble, but occasionally distension of the sac has resulted. The clot formed at the positive pole seems to act as a foreign body, and further coagulation may take place around it, until complete consolidation of the aneurism has resulted. It will be found that a current from ten or twelve cells can be borne for an hour or more, and that no chloroform will be needed for the operation. When the needles are withdrawn the orifices must be closed by collodion. A repetition of the operation is generally necessary, and may be performed at suitable intervals.

G. V. Poore.

ELEPHANTIASIS ARABUM (ἐλέφας, an elephant).—Synon.: Fr. *Éléphantiasis*; Ger. *Elephantiasis*.

Definition.—A non-contagious disease, characterised by recurrence of febrile paroxysms, attended by inflammation and progressive hypertrophy of the integument and areolar tissue, chiefly of the extremities and genital organs; and occasionally by swelling of the lymphatic glands, enlargement and dilatation of the lymphatics, and in some cases by the co-existence of chyluria, and the presence in the blood of certain nematode hæmatozoa; together with various symptoms indicative of a morbid or depraved state of nutrition.

Ætiology.—Elephantiasis is endemic in India, the Malayan peninsula, China, Egypt, Arabia, the West Indies, and parts of America, chiefly in localities within the influence of the sea air; and it occurs sporadically all over the globe, excepting, perhaps, in the extreme north and south. Certain conditions of soil and climate, such as humidity, heat, malarious influences, and proximity to the sea-coast, seem to be concerned in producing the disease and influencing its development. Removal from the territorial endemic area checks the disease, whilst return there reproduces it. Elephantiasis affects both sexes, and persons of all ages and conditions of life. No race is exempt, but it is much more frequent in dark than in fair races; and more men suffer from it than women. It occurs at all ages, but is most common in adult and middle life, comparatively rarely beginning in young children or in the aged. Elephantiasis is doubtfully hereditary; but Richards found that of 236 persons, 73 per cent. had one or both parents affected. Various causes are assigned for the disease. Air, water, food, and, as it is common near the sea-coast, eating fish have been frequently credited with producing it. The presence or vicinity of certain forms of vegetation, and the geological formation of the soil, have also been regarded as predisposing and determining causes. Climate and locality, combined with bad living, are doubtless the real predisposing causes; and it is probable that, as Dr. T. Lewis has suggested, it may be found to be intimately associated with the presence in the blood of certain parasites. No race is exempt from the disease, but, whatever may be the explanation, the white suffer less than the dark races. It does occur occasionally, though very rarely, in the pure European in India, but more frequently in those of mixed descent; it will generally be found that where it occurs in persons of apparently European parentage, there is a mixture, however slight, of dark blood.

Anatomical Characters.—The hypertrophy of elephantiasis in most cases appears to be simply an increase in the natural elements of the part, the blood-vessels and lymphatics sharing in the growth. In other cases the lymphatics and lymph-spaces are most concerned, giving rise to a condition that has been described as *nævoid elephantiasis*, in which the appearance is presented of a soft and fluctuating swelling, which when punctured gives issue to a white or pinkish fluid, very closely resembling chyle. The lymphatic glands also share in the enlargement. In other respects the progress of this is like that of the ordinary form of the disease.

The *Filaria sanguinis-hominis* is sometimes found in great numbers in the blood of persons suffering from elephantiasis. *See* Filaria Sanguinis-Hominis.

Symptoms.—The ordinary form in which elephantiasis presents itself is hypertrophy of the integument and areolar tissue of some part of the trunk or limbs, and notably of the legs and genital organs. The skin becomes enormously thickened by hypertrophy of all the fibrous elements of its structure, attended by the deposit of a quantity of albuminous fluid in the cells of the areolar tissue. The papillæ are prominent and much increased in size. The integument is formed into hard masses or folds, with a rugose condition of the surface, not unlike the appearance of an elephant's leg. The feet and toes are sometimes almost hidden, and the scrotum or labia form enormous outgrowths. The scrotum often attains great weight, and may be accompanied by large hydroceles. Scrotal tumours have been removed weighing upwards of 100 lbs.

The onset of elephantiasis is frequently violent and attended with great suffering. There is

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The more recent researches of Dr. M. Litten, *Zeitschrift für klinische Medicin*, Vol. I., render, however, these views no longer tenable. He shows by experiments on the kidney, spleen, lung, &c., that if the blocked artery be a strictly terminal one, *i.e.* one whose area of distribution has no other arterial supply, the phenomena of the hæmorrhagic infarction do not occur, even though the vein have no halves; and under other circumstances that the infarction takes place although the vein has been ligatured, hence the cause of the infarction cannot be venous reflux. Thus if both the renal artery and vein be ligatured, infarction of the kidney takes place, the kidney receiving a sufficient collateral supply of blood from other sources; but if the capsule were first stripped off, and the kidney be left attached only by the renal artery and vein, no infarction took place, though the vein was left pervious. Similar results were obtained in other organs; hence it would seem evident that the congestion and infarction following embolism are produced by an afflux of arterial blood into the territory from collateral channels. Should these be numerous, and should small arteries open directly into the anæmic territory, the circulation will soon be restored, and no infarction will take place; should, however, the communication be imperfect, and only by means of capillaries, a congestion of the territory leading to diapedesis and infarction will result, the *vis a tergo* being insufficient to propel the blood onwards into the veins.

He has also shown that the vessels in which the circulation has been arrested retain their integrity much longer than was supposed by Cohnheim, and that in the kidney long before the vessels suffer necrosis of the epithelium takes place, the nuclei of the cells disappear, their protoplasm coagulates, and they become converted into swollen hyaline masses (*coagulation necrosis*), which have a remarkable tendency to calcification. Hence the wedge-shaped white embolisms often seen in the kidney are not produced by decolorisation of hæmorrhagic infarctions, but are simply the result of the necrosis of the epithelium; and the halo of injection which is often seen to surround them is due to inflammatory congestion caused by the presence of the necrosed patch.

This explanation of the mode of production of the hæmorrhagic infarction is more closely in accord with the view originally propounded by Virchow, who regarded the hæmorrhage as due to collateral fluxion.

We have now to consider the effects of emboli which possess irritating or poisonous qualities, such as those derived from the puriform softening of venous thrombi in cases of septic inflammation, &c. The mechanical effects will be the same as those of the previous class; but, in addition, these emboli set up a suppurative inflammation in their vicinity, quite independent of any obstruction of the circulation. Hence it is that we meet with pyæmic abscesses, as the result of infecting emboli, in all parts of the body, while the effects of obstructed circulation are, for the most part, confined to certain organs. Thus the liver is very frequently the seat of embolic abscesses, while hæmorrhagic infarctions do not occur there. In the lung, where in parts terminal arteries are found but for the most part there is free anastomosis, the two processes are often seen side by side. The different effects of these two classes of embolism are very manifest in the capillaries. Simple emboli, of such small size as to become first arrested in the capillaries, either cause no permanent change at all, or, at most, produce a punctiform hæmorrhage. Infecting emboli, on the other hand, give rise to the miliary abscesses so characteristic of pyæmia.

W. Cayley.

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Definition.—Agents that produce vomiting.

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Action.—The act of vomiting consists in the simultaneous spasmodic contraction of the diaphragm and abdominal muscles, and relaxation of the cardiac orifice of the stomach, so that its contents are expelled. When the diaphragm and abdominal muscles contract, but the cardiac orifice remains closed, so that the contents of the stomach cannot escape, the expulsive efforts are termed *retching*. The nervous centre which regulates these movements is situated in the medulla oblongata; and it may be excited either directly by the action upon it of drugs carried to it by the blood, or reflexly by irritation of various nerves. The drugs that act directly upon it have the same action, whether they are introduced immediately into the circulation or absorbed by the stomach. They may thus produce vomiting and evacuation of the stomach without being taken into the stomach at all, and on this

account they are termed *indirect* emetics, although they act directly upon the vomiting centre. Such are ipecacuanha, apomorphia, and tartar emetic. Similarly the drugs that excite it reflexly are still termed *direct* emetics, because they are applied directly to the stomach. Such are the sulphates of zinc, copper, and alumina; carbonate of ammonia; salt; mustard; and chamomile, which irritate the nerves of the stomach. Tickling the fauces with a feather, or with the finger, also excites reflex vomiting, and may be adopted either alone, or in order to aid the action of other emetics. The terms *direct* and *indirect*, therefore, as applied to emetics, relate to the stomach and not to the centre for vomiting.

Direct emetics, as they stimulate the nerves of the stomach only, have little action except that of simply exciting vomiting. The indirect emetics, which excite vomiting by their action on the medulla oblongata, act also on other parts of the nervous system, and cause secretion of saliva, secretion of mucus from the œsophagus, stomach, and bronchial tubes, and perspiration. They also cause much nausea, depression of the circulation, and loss of nervous and muscular power. Further, the vomiting they induce is more continuous and violent, and often expels the contents of the gall-bladder, causing part of the bile to flow into the stomach, and be thus evacuated.

Uses.—Emetics are employed to remove the contents of the stomach under various circumstances. Firstly, when the food is causing irritation, and not undergoing proper digestion, as, for example, in dyspepsia or sick-headache; and in such cases large draughts of lukewarm water, of mustard and water, or of an infusion of chamomile are usually found beneficial. Secondly, in cases of poisoning; and here mustard, sulphate of zinc, or sulphate of copper are best, as they empty the stomach most quickly and effectually. Thirdly, to cause the expulsion of bile from the gall-bladder, or remove bile from the body in biliousness, fevers, and ague. When the bile-duct is stopped by a small gall-stone, the pressure exerted on the gall-bladder during vomiting has been known to cause the expulsion of the calculus. In biliousness, excess of bile is more readily removed by vomiting than by purging, as there is no opportunity for the bile to be absorbed on its way from the gall-bladder to the mouth, whereas it may undergo absorption on its passage through the intestines. It is supposed by some that various poisons circulate occasionally in the bile, such as the malarious poison which occasions ague, and possibly other septic poisons which give rise to fevers. The advantage of emetics in ague is undoubted, as it can certainly sometimes be cured by them without quinine, and the action of quinine is always aided by their use. They have also been recommended in the early stages of continued fevers. In such cases tartar emetic or ipecacuanha are most serviceable. Fourthly, to cause expulsion from the air-passages of false membrane in croup or diphtheria, or of secretions in bronchitis and phthisis. For these purposes ipecacuanha is the emetic most frequently chosen, but if it does not act rapidly in croup, sulphate of zinc or sulphate of copper may be employed, and in cases of either croup or bronchitis where there is great depression of the circulation carbonate of ammonia may be used with advantage, as it not only causes vomiting, but at the same time stimulates circulation.

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The *direct* drugs in moderate doses gently stimulate the uterus, promoting the menstrual flow, or even checking it when in excess; but when further pushed they cause powerful contraction of the unstriped muscular fibre, of which its walls are mainly composed. Ergot, which is the principal, and in fact almost the only really useful member of the group, is believed to act either directly on the muscular tissues themselves, or through the intermediate intervention of some central or peripheral nervous influence.

Uses.—Checked or retarded menstruation frequently results from anæmia or general debility, and the indirect emmenagogues will under these circumstances usually effect a cure. If, however, the case prove more obstinate, a little ergot added to the iron will often restore the suspended function. If even this do no good, some mechanical impediment probably exists, or some altered physical condition of the womb which mere drugs cannot rectify. Ergot is frequently employed in cases of lingering labour from simple inertia of the uterus, but its use must be strictly confined to those cases in which there is no marked disproportion between the maternal passages and the head of the child. Advantage is also taken of its contractile powers in the treatment of uterine hæmorrhages, or for the destruction of the smaller varieties of polypi, which are so frequently contained within the womb, by cutting off their blood-supply. Finally, it may be necessary, under certain conditions, to induce abortion or premature labour, as when constant sickness, or albuminuria, or compression of adjoining neighbouring viscera seems to endanger the mother's life, or when pelvic distortion renders it impossible for a living child to be born at full term. When the

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Action.—The *indirect* emmenagogues act by improving the quality of the blood, giving tone to the nervous system, or irritating adjacent parts or organs, from which a stimulating influence is conveyed by reflex action to the womb.

The *direct* drugs in moderate doses gently stimulate the uterus, promoting the menstrual flow, or even checking it when in excess; but when further pushed they cause powerful contraction of the unstriped muscular fibre, of which its walls are mainly composed. Ergot, which is the principal, and in fact almost the only really useful member of the group, is believed to act either directly on the muscular tissues themselves, or through the intermediate intervention of some central or peripheral nervous influence.

Uses.—Checked or retarded menstruation frequently results from anæmia or general debility, and the indirect emmenagogues will under these circumstances usually effect a cure. If, however, the case prove more obstinate, a little ergot added to the iron will often restore the suspended function. If even this do no good, some mechanical impediment probably exists, or some altered physical condition of the womb which mere drugs cannot rectify. Ergot is frequently employed in cases of lingering labour from simple inertia of the uterus, but its use must be strictly confined to those cases in which there is no marked disproportion between the maternal passages and the head of the child. Advantage is also taken of its contractile powers in the treatment of uterine hæmorrhages, or for the destruction of the smaller varieties of polypi, which are so frequently contained within the womb, by cutting off their blood-supply. Finally, it may be necessary, under certain conditions, to induce abortion or premature labour, as when constant sickness, or albuminuria, or compression of adjoining neighbouring viscera seems to endanger the mother's life, or when pelvic distortion renders it impossible for a living child to be born at full term. When the

medical attendant has made up his mind that interference is necessary, he generally has recourse to one or other of the mechanical methods which are fully described in works more particularly devoted to obstetrics.

ROBERT FARQUHARSON.

EMOLLIENTS (*emollio*, I soften).—DEFINITION.—Substances that soften and relax the parts to which they are applied.

ENUMERATION.—The principal emollient applications are:—Warm water, Steam, Poultices made of substances which retain heat and moisture, for example, linseed-meal, bread, bran, flour, oatmeal, and figs; Fatty Substances, as linseed, olive, almond, and neat's-foot oil, lard, and suet; Spermaceti, Wax; Soap Liniment and other liniments; Glycerine; and Paraffines, such as vaseline, unguentum petrolei, &c. To these may be added such substances as do not properly relax the tissues, but protect the surface from irritation, such as White of Egg, Gelatine, Isinglass, Collodion, and Cotton-wool.

ACTION.—Emollients relieve the tension and pain of inflamed parts by their action both upon the blood-vessels and upon the tissues themselves. They cause all the contractile tissues to relax and dilate, and thus, lessening pressure upon the nerves of the part, they relieve pain. They soften superficial parts by supplying them with either fat or moisture, and by increasing the supply of blood. In this way they prevent the skin from cracking after exposure to cold. When the cuticle is lost they form a covering, under which the skin may heal; and they prevent the injurious consequences of friction from without.

USES.—Fatty emollients are used to prevent the skin or mucous membranes from cracking; to prevent irritation or ulceration between parts constantly in contact, as on the limbs of children near the joints; to prevent bed-sores; to aid the healing of blisters; or in skin-diseases, such as eczema. They are also used, especially in the form of linimentum calcis, as applications in burns and scalds, for which purpose such substances as cotton-wool are likewise frequently employed. Mucilaginous substances are useful when swallowed to relieve pain and irritation in the throat, and to lessen irritable cough; and such substances as figs are employed to protect the intestines from injury by hard and pointed substances which have been swallowed. Warmth and moisture are applied in the form of poultices to the surface in pustules, boils, carbuncles, and deep-seated inflammation of the limbs, and in inflammation of the internal organs (*see* POULTICES). In the form of vapour they are useful in inflammation of the air-passages (*see* INHALATIONS).

T. LAUDER BRUNTON.

EMPHYSEMA of Lungs. *See* LUNGS, Emphysema of.

EMPHYSEMA, SUBCUTANEOUS (ἐν, in, and φῦσα, wind).—SYNON.: Fr. *emphysème*; Ger. *Windgeschwulst*.—Subcutaneous emphysema is the distension of the spaces of the areolar tissue with air or any other gas. There is thus produced a swelling, in slight cases affecting a very limited area, in extreme cases extending to the subcutaneous tissue of the whole body. Unless the tension is great the swelling is slightly lobulated; it is elastic, and although the finger sinks readily into it, no lasting impression is left. When the area affected is small, the gas can be driven in any direction by the pressure of the hand. On palpation a peculiar fine crepitation is felt, which is absolutely diagnostic. On percussion there is superficial resonance, the note resembling that obtainable from a bladder loosely filled with air. Unless the gas causing the emphysema is the product of decomposition of gangrenous tissues, as in spreading gangrene, there is no redness of the skin. The swelling usually forms rapidly and may extend in a few minutes over the greater part of the body. In such cases it is most marked where the subcutaneous tissue is lax. In the face the features are obliterated, and the eyes closed by the swelling of the lids. The scrotum and penis become enormously distended.

ÆTIOLOGY AND PATHOLOGY.—Wound of the lung from a broken rib or from a stab is the most common cause of subcutaneous emphysema. If from a stab, it can only occur when the opening in the pleura and that in the skin no longer correspond with each other, in consequence of an alteration in the position of the patient, or when the wound has been artificially closed. When from wound of the lung, it may occur with or without pneumothorax. Nothing is more common than to find a limited emphysematous swelling round a fractured rib, without any signs of air in the pleural cavity. This arises either from adhesions existing between the parietal and visceral layers, or from the escape of air being very limited. In severe cases with pneumothorax the mechanism of the production of emphysema is as follows:—A wound in the lung always allows air to pass from it readily, but from the way in which the soft pulmonary tissue falls together, no amount of force can drive air through the wound in the opposite direction. It thus acts somewhat like the valve of an air-pump. The first effect of the escape of air into the pleural cavity is to cause collapse of the lung. As the chest expands with each inspiration air rushes from the wound in the lung into the pleural cavity: as it contracts in expiration, the air, being unable to pass back by the wound, is driven through the opening in the parietal pleura into the subcutaneous cellular tissue. In such cases there is gradually increasing dyspnœa, with great distension of the subcutaneous cellular tissue, and unless relief is given the patient dies asphyxiated.

Emphysema occasionally occurs from rupture of some of the air-vesicles during a violent expiratory effort. Walshe states that this accident has happened from 'the efforts in parturition, defæcation, raising weights, coitus, violent coughing, paroxysms of rage, excessive laughter, and hysterical convulsions.' The air usually escapes first into the cellular tissue between the lobules of the lung, giving rise to the condition known as *interlobular emphysema*. It then finds its way into the mediastinum and from thence to the root of the neck. Interlobular emphysema gives rise to intense dyspnœa, and has been known to cause sudden death. Emphysema has also been seen as a consequence of ulceration of the trachea, and in a few very rare cases as the

result of ulceration proceeding from a cavity in the lung through the adherent pleura and intercostal muscles to the subcutaneous cellular tissue.

Localised emphysema of the face is a symptom of fractures implicating the antrum.

Emphysema of the flanks is an occasional symptom of rupture of the third part of the duodenum, behind the peritoneum, and of perforation of the cæcum at its posterior part.

Emphysema of the perineum and scrotum may arise from a wound of the bowel in the administration of an enema.

In non-penetrating wounds of the thorax and abdomen, a small quantity of air may find its way into the areolar tissue in the immediate neighbourhood, in consequence of the movements of respiration. In compound fractures emphysema is often found extending some distance above and below the wound, if the patient has been carried some distance and the injured limb much shaken.

Emphysema from the gases produced by decomposition is only seen in cases of rapidly spreading moist gangrene.

Progress and Terminations.—The effects of emphysema differ with the source of the gas. When the air comes from a superficial wound of the lung, it has no tendency to cause decomposition of the effused blood with which it may come into contact. Thus, in surgical cases, no evil consequences result from emphysema around a simple fracture of a rib. This is explained by the fact that the gas in the air-vesicles is absolutely free from solid particles of any kind; as shown by Tyndall's experiment, in which the residual air, in forced expiration, makes a gap in the beam of an electric light when breathed across it. On the other hand, air admitted from without, as in a compound fracture, tends to favour the decomposition of the effused blood, and renders treatment by occlusion or by antiseptic dressing difficult and uncertain. In ordinary cases the effused air is rapidly absorbed without causing inconvenience of any kind. If the amount of air in the tissues be very great, and the case be complicated by pneumothorax, fatal dyspnœa may occur, unless relieved by treatment.

Treatment.—The swelling itself requires usually no treatment, the gas being absorbed without difficulty. If it is complicated by pneumothorax, or if the dyspnœa be such as to threaten death, the wound, if one exists, must be opened up, or, if there is none, a free opening must be made into the pleural cavity. If the swelling be such as seriously to inconvenience the patient, a few punctures may be made with a triangular needle. Emphysema from intestinal flatus is always limited, and requires no treatment beyond that applicable to the cause of the escape of gas. Marcus Beck.

EMPIRICAL (ἐν, by, and πεῖρα, experience). This term is applied to treatment founded on experience, as opposed to *rational*, founded on scientific reasoning. *See* Disease, Treatment of.

EMPROSTHOTONOS (ἔμπροσθεν, forwards, and τείνω, I stretch.)—A bending or drawing forwards of the body, due to tonic contraction of the muscles, observed in some cases of tetanic convulsions. *See* Tetanus.

EMPYEMA (ἐν, in, and πύον, pus).—Strictly speaking this term signifies a collection of pus within the cavity of the pleura, but it is often conventionally used to denote any inflammatory effusion in that situation which has assumed a chronic character. *See* Pleura, Diseases of.

EMS, in Germany.—Thermal muriated alkaline waters. *See* Mineral Waters.

ENCEPHALITIS (ἐγκέφαλος, the brain). Inflammation of the brain and its membranes; or, more properly, inflammation of the brain-substance itself. *See* Brain, Inflammation of.

ENCEPHALOCELE (ἐγκέφαλος, the brain, and κήλη, a tumour).—A hernial protrusion of a portion of the brain-substance through an opening in the skull, which may be either congenital or the result of accident. *See* Brain, Malformations of.

ENCEPHALOID (ἐγκέφαλος, the brain).—A form of cancer, so named on account of its obvious resemblance to brain-tissue. *See* Cancer.

ENCHONDROMA (ἐν, in, and χόνδρος, cartilage).—A new-growth consisting of cartilaginous tissue. *See* Tumours.

ENCYSTED (ἐν, in, and κύστις, a bladder).—Contained within a cyst. A term applied to new-growths or collections of fluid thus enclosed.

ENDARTERITIS (ἔνδον, within, and ἀρτηρία, an artery).—Inflammation of the internal coat of an artery. The disease is generally chronic or subacute, rarely acute. Two special forms of endarteritis have been described, namely, *endarteritis deformans*, or atheromatous disease (*see* Arteries, Diseases of, and Atheroma); and *syphilitic endarteritis*, which most frequently affects the vessels of the brain, but the specific nature of which has lately been questioned (*see* Syphilis, and Brain, Vessels of, Diseases of).

ENDEMIC (ἐν, in, and δῆμος, a people).—This term is applied to diseases that prevail in particular localities or districts, and which are due to special ætiological conditions existing there. *See* Disease, Causes of.

ENDERMIC (ἐν, in, and δέρμα, the skin). A term generally applied to the method of introducing remedies through the skin. The horny layers of the cuticle interpose so effective a barrier between most remedial agents and the absorptive surface of the true skin, that the endermic plan of treatment when introduced was looked upon as a therapeutic gain. The ease with which drugs could thus be administered, and the excellent results obtained in neuralgia and other nervous affections, were held to far more than counterbalance the pain of the application, the resulting disfigurement, and the occasional troublesome ulceration which ensued. And, although the hypodermic syringe, with its greater rapidity and efficiency, has rendered the endermic method almost obsolete, there are still circumstances which might induce us to use it. For instance, a blistered surface might be ready to hand; or it might be considered advisable to combine counter-

irritation with the subsequent local use of morphia or other sedative drugs; or it might not be possible to procure an instrument for subcutaneous injection, or an invincible objection might be made to the needle-prick, which is sometimes a source of apprehension to sensitive natures, and we might then be glad to avail ourselves of a moderately efficient substitute.

Mode of Application.—We detach the epidermis either by any ordinary blistering application, or by the button-cautery, and after its careful removal, we apply our selected drug to the raw surface, in the form either of powder or of an ointment, which latter plan has seemed to the writer rather more efficient, as ensuring more prolonged contact, the application being also less easily washed away by the effusion of serum from the skin. The principal remedies used in this way have been morphia, which, in doses of from a quarter of a grain to two grains, is undoubtedly beneficial in cases of neuralgia, sciatica, and localized rheumatism; strychnia, which was formerly much employed in amaurosis, lead palsy, infantile paralysis, and other nervous affections, in doses of from $\frac{1}{12}$-grain to one grain; and quinine, which in 6-grain doses has apparently cured obstinate cases of ague.

Robert Farquharson.

ENDOCARDITIS (ἔνδον, within, and καρδια, the heart).—Inflammation of the lining membrane of the heart. *See* Heart, Inflammation of.

ENDOGASTRITIS (ἔνδον, within, and γαστήρ, the stomach).—Inflammation of the mucous membrane of the stomach. *See* Stomach, Diseases of.

ENDOMETRITIS (ἔνδον, within, and μήτηρ, the womb).—Inflammation of the lining membrane of the uterus. *See* Womb, Diseases of.

ENDOPERICARDITIS. — Inflammation of the endocardium and pericardium together. *See* Heart, Inflammation of; and Pericardium, Diseases of.

ENEMA (ἐνίημι, I inject).—Synon.: Lavement; Clyster; Fr. *Clystère; Lavement*; Ger. *Klystier*.

Definition.—An enema is a liquid injected by means of a suitable instrument into the rectum or the colon.

Instruments.—Various instruments are used for the administration of enemata:—1. A simple elastic bottle with ivory or gum-elastic pipe, which has superseded the old bag and pipe. 2. An india-rubber bottle with flexible tube at either end and double action. 3. An ordinary piston syringe, worked by the hand, which is either simple, or provided with a double action, so as to supply a continuous stream. The *simplex enema* made by Messrs. Arnold is very convenient; the piston works on a spring, and requires no packing. 4. A French instrument, known as the *irrigateur*, worked by a spring. 5. The hydraulic enema, which consists of a piece of india-rubber tubing about six feet long, furnished with an ordinary ivory rectum-pipe at the one end, and a metal cone, or a screw nozzle, at the other. The tube, being filled with the injection, has one end placed in the containing reservoir, or is connected by the screw; while the pipe at the other end is introduced into the bowel. The vessel supplying the injection being placed on an elevation, the liquid gravitates into the bowel, filling the large intestine. When it is desirable to inject a large quantity the patient should lie first on the left side, then on the back, and lastly on the right side, to promote the filling of the whole intestine. In all cases care should be taken to prevent the injection of air into the bowel, and also to ascertain that the nozzle of the injecting pipe is free in the rectum, not thrust against the sacrum, or into a hard fæcal mass.

Varieties and Uses.—The chief varieties and uses of enemata are as follows:—

1. **Anthelmintic Enemata.**—To cure thread-worms injections of salt and water, or lime-water, or from two to four drachms of spirits of turpentine diffused by yolk of egg in four ounces of water are serviceable. The enema of aloes or of assafœtida may also be employed in the small quantity just named.

2. **Antispasmodic Enemata.** — Puerperal convulsions have been relieved by the injection of half a drachm or more of chloral hydrate. Injections of assafœtida or of rue are also given. Injections of warm water with ʒij or ʒiij of sulphuric ether have sometimes relieved spasmodic invagination of the bowels. When the intestine is tympanitic and distended, the enema terebinthinæ acts well as a stimulant and carminative.

3. **Astringent Enemata.**—These are used either to check diarrhœa, to arrest hæmorrhage, or to cure ulceration and mucous discharges. For the first of these purposes the enema opii is valuable. In cases of hæmorrhage from the bowels, as well as from the womb, injections of ice-cold water are frequently used. Ulceration with mucous discharge is often successfully treated by enemata of nitrate of silver (five grains to one pint of distilled water), of sulphate of zinc or alum (one or two grains to the ounce of water), or of sulphate of copper (one grain to the ounce of water).

4. **Emollient Enemata.**—Demulcents, such as decoctions of starch, linseed, or barley, or pure linseed oil, are at times used with the object of imparting nourishment to the system, and of soothing an irritable mucous membrane.

In dysentery, from four to six pints of warm water, or of milk and water, have been injected as an internal fomentation.

5. **Nutrient Enemata.** — In cases of exhaustion enemata of beef-tea and eggs beaten up are used; about four or six ounces should be given at once. Should the rectum become irritable, the irritability may be often lessened by adding a few drops of laudanum to each enema. Defibrinated blood, in its recent or dried form, has lately been recommended as a material for nutrient enemata (see paper by Dr. Sansom on Supplementary Alimentation, *Lancet*, 1881, vol. i. p. 288). The digestion and assimilation of nutrient enemata may be facilitated by the addition of preparations of pancreas and pepsine. *See* Peptonised Food, page 1116.

injections of brandy and water, or beef tea and brandy, have been given with benefit in prostration from uterine hæmorrhage.

6. **Sedative Enemata.**—These are often employed in painful affections of the rectum and bladder. The enema opii, containing half a drachm to a drachm of tincture of opium, is well suited. In spasm of the bowels and in hernia the enema tabaci may be resorted to, but it may produce faintness and collapse. An infusion of twelve grains of dried belladonna leaf in six ounces of hot water is also used with advantage.

7. **Purgative Enemata.**—These are used to overcome constipation. For this purpose—in the case of an adult—from one to two pints of fluid must be slowly pumped into the bowel. If the process be conducted gradually, stopping occasionally and making pressure on the anus if the injection threaten to come away, as much as four or five pints can be got into the bowel. The injection should be retained as long as possible, as thus a complete evacuation is insured. As a general rule about a pint of liquid is enough for an adult; for an infant an ounce; for a child of four years, four to six ounces.

Composition.—Soap and water, gruel with olive oil, castor oil, and sometimes oil alone, may be used. The enema magnesiæ sulphatis contains one ounce of epsom salts, and is an efficient purgative. Enema aloes is also recognised. In cases of intestinal obstruction the introduction of a large volume of soap and water—with oil, perhaps, added—by means of the gravitation-tube, may be had recourse to with advantage. Obstruction due to impacted fæces generally yields to this method of treatment.

The frequent use of very large injections is undesirable, lest undue distension result. The frequent use of injections washes away the mucus designed to lubricate the bowel.

JOHN C. THOROWGOOD.

ENGADINE, UPPER, in Switzerland.—A bracing mountain climate. Elevation of valley 5,000 to 6,000 feet. Season, June to September. *See* CLIMATE, Treatment of Disease by.

ENGHIEN, in France.—Sulphur waters. *See* MINERAL WATERS.

ENGLISH CHOLERA.—A synonym for simple cholera or choleraic diarrhœa. *See* CHOLERAIC DIARRHŒA.

ENGORGEMENT.—Overloading of the vessels, or of the heart, with blood. A synonym for congestion. *See* CIRCULATION, Disorders of.

ENTERALGIA (ἔντερον, the intestine, and ἄλγος, pain).—SYNON.: Enterodynia; *Neuralgia mesenterica vel meseraica*; Colic.

The terms enteralgia and colic—generally regarded as synonymous—include all forms and degrees of paroxysmal intestinal pain in cases where there is no febrile disturbance. Enteralgia, implying more especially the neuralgic nature of the sensori-motor disturbance, is sometimes preferred, as by those who hold that colic proper—of which lead-colic is a typical example as distinguished from symptomatic colicky pains—is a visceral neuralgia. It is likewise frequently applied to colic occurring in neurotic, asthenic, anæmic, or gouty subjects, even when there is a local exciting cause, such as flatus, retained fæces, &c.; and to conditions in which pain predominates over spasm. The clinical features of enteralgia are, however, indistinguishable from those of colic; a similar local disturbance, according to its intensity, is reflected by the nerves to the heart and the peripheral arteries—the action of the former becoming slow and feeble, and the latter contracting, hence arising the small, infrequent, tense pulse, the cool pale skin, and the other signs of collapse which mark the distant effects of colic; and, as in this disorder, the termination of the attack may be sudden, perhaps following the expulsion of flatus or fæces—a free perspiration, a copious flow of pale urine, the menstrual or lochial or other discharge, or a fit of the gout.

TREATMENT. — The main indications in the treatment of enteralgia are to endeavour to remove any cause of the pain; and to administer opium or other anodynes for the relief of the suffering. *See* COLIC, INTESTINAL.

GEORGE OLIVER.

ENTERIC FEVER. — A synonym for typhoid fever. *See* TYPHOID FEVER.

ENTERITIS (ἔντερον, a bowel).—Inflammation of the intestines. *See* INTESTINES, Diseases of.

ENTEROCELE (ἔντερον, a bowel, and κήλη, a tumour).—A hernia containing a portion of bowel. *See* HERNIA.

ENTOPHYTE (ἐντὸς, within, and φυτὸν, a plant).—A plant parasitic in any part of the body. *Entophytic Diseases* are diseases that are supposed to depend upon the growth of such plants, as, for example, fungus-foot. *See* FUNGUS FOOT OF INDIA.

ENTOZOA (ἐντὸς, within, and ζῶον, an animal).—This term not only embraces all the animal parasites coming under the category of 'worms,' or 'intestinal worms,' but also a great variety of creatures which take up their residence in the soft and hard tissues as well as in the cavity of the digestive organs of their human and animal bearers. Under the article PARASITES is given a definition which will probably be found more comprehensive than any hitherto offered. In this place, with the double view of facilitating reference and supplying an epitome of the whole subject, a complete alphabetical list of the separate headings under which the entozoa are discussed in the body of this work is appended. The articles stand as follows:—Acephalocysts; Ascarides; Bilharzia; Bladder-worms; Bothriocephalus; Chigoe (Sandworm); Cysticercus; Demodex: Distoma; Dracunculus; Echinococcus; Echinorhynchus; Fasciola; Filaria; Filaria Sanguinis-Hominis; Fluke; Guinea-worm; Hæmatozoa (Blood-worms); Helminths; Hydatids; Intestinal worms; Lumbricus; Measle; Œstrus (Bots, Maggots, Insect Parasites, Gadfly); Oxyuris; Parasites; Pentastoma; Round-worms; Sclerostoma (Anchylostomum. Dochmius); Seat-worm; Tænia; Tape-

worm; Thread-worm; Trichina; Trichinosis; Trichocephalus; Vermes; Whip-worm.

The Ectozoa are noticed under the article EPIZOA. T. S. COBBOLD.

ENTOZOON FOLLICULORUM. — A synonym of the animalcule of the follicles of the skin, otherwise named acarus (Simon), demodex (Owen), and steatozoon folliculorum (Erasmus Wilson). *See* ACARUS and DEMODEX.

ENTROPION (ἐν, in, and τρέπω, I turn).—A morbid condition in which the eyelid is inverted, so that its free margin is directed towards the eye. *See* EYE and its Appendages, Diseases of.

ENURESIS (ἐν, in, and οὐρέω, I pass the urine).—Involuntary discharge or incontinence of urine. *See* MICTURITION, Disorders of.

EPHELIS (ἐπί, due to, and ἥλιος, the sun).—SYNON.: Sunburn; Fr. *Ephelide*; Ger. *Sonnenflecken*.—This word is applied to pigmentary discoloration of the skin, of a brown, grey, or black colour, resulting from the stimulus of light and heat, as of the sun's rays, or scorching by fire. Two principal varieties of the affection have been noted, namely, Ephelis solaris, and Ephelis ignealis. *See* PIGMENTARY SKIN-DISEASES.

ERASMUS WILSON.

EPHEMERAL FEVER (ἐφ', upon, and ἡμέρα, a day).—A mild form of milk-fever, so called on account of the rapidity with which it subsides, lasting not more than a day. *See* MILK-FEVER.

EPHIDROSIS (ἐπί, upon, and ἱδρόω, I sweat).—A term signifying a state of sweating, and synonymous with Idrosis. *See* PERSPIRATION, Disorders of.

EPIDEMIC (*epidemicus*, affecting the people; from ἐπί, upon, and δῆμος, a people).—The word epidemic is used in two senses by medical writers and by medical men, namely, (1) in a general sense, and (2) in a technical sense.

As a *general term* the word signifies 'common to, or affecting, a whole people, or a great number in a community; prevalent; general.' (*Webster's Dictionary.*) It is in this sense that the word is used when it is applied to mental, moral, and social phenomena, as, for example, when we speak or write of 'epidemic suicide,' 'epidemic folly.' This employment of the word is consistent with received literary practice. Thus we read, 'There was a time when *wit was epidemic*.' (*Athenæum.*) Again, M. Littré, writing to the *Temps*:—'It argues great confidence in oneself and one's own enlightenment to treat with haughty disdain, and without reserving any compromise, the opinion of so many citizens, and to regard it as a case of *epidemic aberration*.'

As a *technical term* having reference to disease, the word epidemic has several different meanings attached to it. All these meanings include the notion of general prevalence among a community or a people, but some of them would go on, beyond what etymology justifies, to attach a peculiar hypothetical or theoretical conception to the term. Thus (*a*) Mayne restricts the term to diseases which are contagious, making contagion the essence of *epidemicity*, as he would phrase it; (*b*) Dunglison implies by the term a particular constitution of the air ('*constitutio aeris*, or condition of the atmosphere'); (*c*) other authoritative writers use the term as signifying a widespread cause, telluric, atmospheric, cosmic, as the case may be, acting at the same moment of time on many individuals, or as something occult, regarding which speculation is vain, and which they designate *epidemic constitution* or *epidemic influence*.

The foregoing technical significations attached to the word epidemic are not less misleading than insufficient. Mayne's definition imposes an arbitrary limitation upon the meaning of the word, while it involves but a partial notion of the phenomena of epidemic prevalence of contagious diseases. Dunglison's definition does not rest upon a scientific foundation, and its phraseology, derived from a period when medicine was still hampered with semi-mystical speculations, cannot well be dispossessed of the vague traditional meanings which adhere to the word 'constitution.' Other technical definitions (if that can be called a definition which makes obscure what should be rendered clear) rest on mere assumptions or relegate the term to the incomprehensible and insoluble. Of these last-named definitions Léon Colin has recently said:—'They signify implicitly a common cause, apparently indecomposable, to which individuals are not exposed successively but simultaneously . . . . a something isolated, impersonal, inaccessible to reason, detached from the disease itself, the epidemic genius [constitution, influence] . . . . a creative force of the different epidemic affections, compelling, directing, extinguishing them.'

The promiscuous use of the word *epidemic* in medical literature and medical talk, and the different irreconcileable significations attached to it as a technical term, have been, and still continue to be, sources of almost hopeless confusion in treating of diseases in respect to which the phenomenon of (etymologically) epidemic prevalence is observed. It is not difficult to apprehend how this has come about. The diseases in question (the *morbi populares* of some writers) include among their number plague, the eruptive and continued fevers, influenza, malignant cholera, &c. 'They have the peculiar character of attacking at intervals great numbers of people within a short period of time; they distinguish one country from another, one year from another; they have proved epochs in chronology; and, as Niebuhr has shown, have influenced not only the fate of cities, such as Athens and Florence, but of empires; they decimate armies, disable fleets; they take the lives of criminals that justice has not condemned; they redouble the dangers of crowded hospitals; they infest the habitations of the poor, and strike the artizan in his strength down from comfort into helpless poverty; they carry away the infant from the mother's breast, and the old man at the end of life; but their direst eruptions are excessively fatal to men in the prime and vigour of age.' (WM. FARR.) Exercising at all times in their greater and more fatal prevalence the profoundest influence over the mind, as well of the people generally as of the medical profession, these diseases, partly from the terror

they inspire, partly from the extreme complexity of the phenomena they display, have formed a never-ceasing subject of the wildest speculation. No part of medicine has retained so much of the semi-mystical teachings of the older physicians as that which relates to epidemics, and general history has contributed with medical history to propagate in regard to epidemics that habit of thought which refers the unknown to the occult—using the latter term in the sense in which it is applied with regard to the imaginary sciences of the Middle Ages. Much of the speculation as to epidemics which passes current for science at the present day is in reality an unsuspected continuation of the mystical teachings of earlier medicine: magnetism, or electricity, for example, taking the place of Saturn or Mercury in the scheme of causation. The terminology is modernised, but the underlying conception remains the same. Again, the so-called '*precursors*' of epidemics which still find a place in treatises on medicine are the relics of the doctrine of portents of the Middle Ages. They rest on the assumption of an epidemic being determined by some common extra-mundane or intra-mundane cause, of which it is but one of several effects. The celestial 'portents,' such as comets and meteors, and the more manifest telluric 'portents' such as earthquakes and volcanic eruptions, have been discarded; but the 'portents' derived from exceptional developments of insect life, from murrain, from unusual prevalence of certain diseases, and from remarkable perturbations of the weather, are retained under the denomination of 'precursors.' For example, the earlier epidemics of malignant cholera which visited Europe were believed to have been heralded by an unusual prevalence of 'fevers' and of diarrhœal affections. The epidemic of 1865–66 gave an excellent opportunity of studying the facts bearing on this question. Europe was taken by surprise when cholera appeared in 1865, on the south coast of the Mediterranean, at Alexandria, and began thence to extend rapidly to the southern and eastern shores of that sea. It was not, indeed, until the disease had effected a lodgment in several parts of the Continent that the attention of governments and the public with regard to it was fully aroused. No change of the public health in the several places visited by the epidemic had occurred of such a nature as to give rise to any, even the least suspicion, of impending pestilence. Moreover, notwithstanding the prevalence of steppe murrain and of cerebro-spinal fever in Northern Europe at the beginning of 1865, there was nothing to suggest (indeed it was not suggested) that these phenomena were 'precursors' of the coming epidemic of cholera, or of the extension of yellow fever to the shores of England the same year. In fact, the different occurrences were parts of contemporaneous rather than successive phenomena. The condition of the public health preceding the appearance of cholera in England, and especially in respect to diarrhœal antecedents, was made the subject of careful study by the late Professor Parkes and others. These observers failed to obtain any inkling of a change in the public health which could be regarded as presaging pestilence—of the existence, in short, of any so-called 'epidemic constitution.' It is true that John Sutherland had described an increase of 'fevers' and diarrhœal disease in Malta, as preceding the appearance of cholera there, in June 1865, observing that:—'These facts are sufficient to show that long before cholera began to come towards the north-west, there were indications of a changed condition of the public health in Malta;' and after giving an account of two groups of choleraic cases which occurred in May, he adds, 'It appears to me scarcely possible to escape from the conclusion that long before cholera appeared in Malta, possibly before the first outbreak in Arabia, the earliest wave of the coming epidemic had passed over those islands.' But while, according to Dr. Sutherland, the coming epidemic was thus clearly foreshadowed in Malta, no change in the public health presaged its appearance in Gibraltar in July. The absence of all foreshadowing of the epidemic at Gibraltar can hardly be reconciled with the suggested presence of such foreshadowing at Malta. The facts which have been interpreted as presaging the appearance of cholera in the latter island are, indeed, to be regarded as coincidental rather than related. It is true, also, that MM. Didiot and Gués have endeavoured to show that prior to the appearance of cholera at Alexandria in 1865, choleraic disease existed in Marseilles, and that the outbreak of the epidemic in the latter town was preceded by 'une constitution médicale cholérique.' The evidence they advance in support of their conclusions simply shows that deaths from infantile cholera, which, as they properly remark, is 'à la vérité, fréquente à Marseille,' and from so-called 'sporadic' cholera, are apt to occur in Marseilles during the months of May and June, as perhaps in every city and town of southern and central Europe.

Another illustration to the same effect as the above, in regard to the 'precursors' of epidemics, is furnished by the history of the small-pox epidemic of 1869–73, the greatest epidemic of this disease in recent times—a true pandemic (*πάνδημος*, from *πᾶν*, all, and *δῆμος*, the people) extension of the malady. The acutest observers were taken by surprise with the malignity and diffusibility of the disease during the epidemic—phenomena wholly unforeseen. Here, again, the study of the diseases preceding or accompanying the epidemic yields no facts of variation in their prevalence, from which the approach of a great epidemic might have been inferred, nor give any hint that they were dependent with it on some common cause.

There were *concurrent* phenomena of disease during both epidemics, but they were concurrences of certain diseases existing at the same time among the population affected by the great epidemic, and some of them probably having certain secondary elements of causation in common. This is a different question to that of an assumed 'epidemic influence' or 'epidemic constitution.' The subject of the *concurrence of epidemics* is a new field of investigation, which has lately been opened by an arithmetical study of George Buchanan's, relating to epidemics in numerous extra-metropolitan registration sub-

districts in England. This study was directed to ascertain—as necessarily introductory to a statistical investigation regarding community of causation or mutual antagonism of various epidemics—the arithmetical probability of their concurring as a mere matter of chance. The data used were taken from a particular quarterly return of the Registrar-General, and they extended to 946 occurrences of epidemics (small-pox, measles, scarlet-fever, diphtheria, whooping-cough, fevers, and diarrhœa and simple cholera) in 1,490 districts. The result showed a good deal of general correspondence between the calculated number of concurrences and the actually observed number, but with departures, of more or less magnitude, of the actual from the calculated degree of concurrence, which deserve to be followed up by further investigation. The departures were shown in an excessive frequency of the concurrence of measles with the other epidemics, of diarrhœa with all other epidemics except small-pox, and of scarlet-fever with the 'fever' of the Registrar-General. On the other hand, it is of interest to observe that there was an absence of any notable excess of frequency of concurrence between scarlet-fever and diphtheria, or between scarlet-fever and whooping-cough.

In view of the extreme looseness with which the word *epidemic* is used in medicine, sometimes simply as a descriptive term, sometimes as a technical or quasi-technical term involving various hypothetical and theoretical conceptions inconsistent with each other, and sometimes as implying an occult influence, it would be well if it could be discarded from medical literature and language. *Epidemic*, in its present medical uses, is an instance of words which, as Bacon says, when writing of the effects exercised by a bad and inapt formation of words on the human mind, 'force the understanding, throw everything into confusion, and lead mankind into vain and innumerable controversies' (*Nov. Org.* App. 43). But the retention of the word, from its long and familiar usage, is practically a necessity in medicine; moreover, it would be difficult if not impossible to find a substitute which, if the word be used in its ordinary signification, would supply its place.

It is suggested here that the technical meaning of the word epidemic should be assimilated to the common meaning; or, more accurately, that the technical meanings now attached to the word should be abandoned, and the word used in medicine in the same sense as in general literature and in ordinary converse; that is to say, as a merely quantitative term applicable to particular phenomena, whether pathological, mental, or social, in so far as they are 'common to a whole people, or to a great number in a community;' or in a word are 'prevalent' or 'general.' In this way not only would the confusion arising from the present medical uses of the word be got rid of, but the scientific study of epidemic phenomena would be facilitated in the only direction which gives promise of successful issue. As Léon Colin has aptly written: —'It is the disease which constitutes the epidemic, not the epidemic the disease. The evil always remains the same, the number of affected alone being increased.' The medical study of epidemics is essentially a study of the individual diseases which are apt to become epidemic, and not, as has been too commonly the case hitherto, of some figment of the imagination (*epidemic constitution*, or *influence*, or *genius*), apart from the diseases. It is only in proportion as researches have been directed to particular diseases liable to become epidemic, and to the conditions under which they prevailed epidemically, that recent advances in our knowledge of epidemics have been made. In this country the two most important events which have occurred in this connection of late years were the discrimination of *typhus* from *typhoid*, by A. P. Stewart and Wm. Jenner, and the researches on the *typhus of horned cattle* (steppe-murrain, *cattle-plague*), promoted by the Royal Commission of 1865–66, on Cattle-Plague. The discrimination of typhus from typhoid proved that the voluminous speculations which to that time were current on the epidemiology of the continued fevers of this country, then regarded as but *one* disease presenting several varieties, were for the most part meaningless verbiage, by showing that the two most common forms of fever were distinct diseases clinically, pathologically, and ætiologically. This discovery proved to be the inauguration of a true method of investigation concerning epidemics, by making evident that epidemic phenomena did not admit of accurate study, except in so far as it was based upon a just discrimination of the diseases manifesting them, and upon their clinical and pathological histories. The same lesson was taught, not less clearly, although in another fashion, by the researches promoted by the Royal Commission on Cattle Plague, with which the names of Lionel Beale and Burdon Sanderson are especially connected. These researches demonstrated the essentially infectious nature of the malady, and that its prevalence was dependent upon the dissemination of the infection, directly or indirectly, from animals sick of the disease to the healthy. It was shown, indeed, in the pathological laboratory, that preconceived doctrines of some occult epidemic influence which had been submitted to the Commission as determining the prevalence of the cattle-plague had no existence in fact when the disease was subjected to experimental study, and that its conditions of prevalence were fully within human control. These researches proved the starting-point of those important investigations on the intimate pathology of contagion carried out by Burdon Sanderson and Klein, for the Privy Council, under the direction of John Simon, and to which Wm. Roberts and others have independently contributed so largely —investigations which promise speedily to revolutionise our knowledge of the intimate pathology of infectious diseases. It is interesting to note that the Royal Commission on Cattle-Plague included the following medical members:—Richard Quain (M.D.), H. Bence Jones, E. A. Parkes, T. Wormald, and R. Ceely. *See* also PERIODICITY IN DISEASE.

J. NETTEN RADCLIFFE.

EPIDEMIC CEREBRO-SPINAL MENINGITIS.—A synonym for cerebro-spinal fever. *See* CEREBRO-SPINAL FEVER.

EPIDEMICS, Occurrence of. *See* PERIODICITY IN DISEASE.

EPIDERMIS, Diseases of. *See* SKIN, Diseases of.

EPIDERMOPHYTON (ἐπί, upon; δέρμα, the skin; and φυτόν, a plant).—The name of the epiphyte, or parasitic fungus, of phytosis versicolor, also called Microsporon. *See* EPIPHYTA.

EPIDIDYMITIS (ἐπί, upon, and δίδυμος, a testicle).—Inflammation of the epididymis. *See* TESTES, Diseases of.

EPIGASTRIC REGION.—This region is situated at the upper and central part of the abdomen, just below the ensiform cartilage, and between the sloping margins of the thorax down to the level of the ninth cartilage, corresponding to what is popularly known as the 'pit of the stomach.' The structures within the abdominal cavity which normally occupy the epigastrium are the greater part of the stomach, a small portion of the liver, and more deeply a part of the pancreas, the aorta giving off the cœliac axis and superior mesenteric branch, the vena cava inferior, the veins forming the commencement of the portal vein, the receptaculum chyli, and the solar plexus.

CLINICAL INVESTIGATION.—Clinically, it will be found that patients frequently complain of abnormal sensations specially referred to the epigastrium. These are generally associated with the stomach, and may merely amount to a sense of discomfort, fulness, or tightness; or to actual pain of varying character, more or less severe according to the condition upon which it depends, and often much influenced by the ingestion of food. Sensations of trembling, throbbing, or sinking in the pit of the stomach are also of common occurrence, especially in females. These are often merely of a nervous character. In some cases there is evident tenderness, either over the entire epigastrium or in some limited spot, and it is important to recognise whether this is superficial or felt more or less deeply, for it may be connected with the superficial structures, the peritoneum, the liver, the stomach, or the pancreas. The sensation experienced in connection with hunger is referred mainly to the epigastrium, and it may be of a painful character. Here may also be noticed the epigastric pain termed *gastralgia* or *gastrodynia*, which is usually felt chiefly when the stomach is empty, being relieved by taking food. A most unpleasant sensation at the pit of the stomach accompanies nausea, which may be of a horrible but indescribable character; while violent vomiting or retching causes considerable pain or aching in this region, partly associated with the stomach, partly with the abdominal walls. Heartburn is another sensation which seems to start from the epigastrium. Sometimes the pain is situated deeply, or shoots towards the back. This may depend upon disease affecting the posterior wall of the stomach, pancreatic disease, aneurism, or other causes. A sensation of tension or actual pain is sometimes experienced just below the ensiform cartilage in cases where the diaphragm is much pressed downwards, as from extreme emphysema, abundant accumulation of fluid or air in the pleura, or extensive pericardial effusion. A deep pain is not uncommonly referred to the epigastrium in cases of Addison's disease, and also in those of pernicious anæmia. Probably this is connected with the sympathetic plexuses.

Physical examination of the epigastric region is often of the greatest value, and important objective signs of various morbid conditions may thus be readily recognised. Of course organs which are normally confined to other regions may enlarge so as to extend into the epigastrium, or may become very movable and consequently be felt in this region. It may, moreover, be occupied, along with other parts of the abdomen, by growths or accumulations of fluid. The objective signs and conditions which are more especially connected with the epigastrium may be indicated as follows:—

1. It is customary to apply the hand over the epigastrium for the purpose of counting the respirations, if these cannot be reckoned by merely watching the patient breathing.

2. Morbid conditions of the abdominal walls may be confined to the epigastric region, such as an abscess; and here it may be remarked that the recti muscles frequently become very hard and rigid when palpation is practised over this part, and so might be in danger of being mistaken for some serious lesion, unless care were exercised in the examination.

3. Growths connected with the peritoneum, especially the great omentum, may be felt chiefly or entirely in the epigastrium in some instances.

4. Abnormal states of the stomach are necessarily revealed mainly by corresponding signs in the epigastrium. Thus there may be evidence of dilatation of this organ; carcinomatous infiltration of its anterior wall; a localised tumour; or of some accumulation in its interior, whether solid or liquid. It must be remarked, however, that the stomach, when diseased, frequently extends into other regions beyond the epigastrium.

5. When the liver is the seat of organic disease, this is often revealed in the epigastric region, usually along with other regions, but sometimes the abnormal physical signs are noticed specially in this part. Thus a cancerous mass may present here, or a hydatid tumour or hepatic abscess may tend in this direction. The gall-bladder has also occasionally been found, when the seat of some accumulation or of malignant disease, to have been displaced towards the epigastrium and become fixed there.

6. Pulsation is not uncommonly felt in the epigastrium. When situated at its upper part, just below the ensiform cartilage, it depends upon the heart, usually its right side, being due either to shortness of the sternum, displacement of the heart, or enlargement of its right cavities. Very often a pulsation is felt, and sometimes even seen, due to a pulsating aorta; and an impulse from this vessel may be transmitted through an enlarged pancreas, or through an abscess of the liver, of which the writer has seen a marked example. Occasionally an impulse in the epigastrium is connected with an aneurism, either of the aorta or of one of its branches. A pulsation in this region has also been attributed to regur-

gitation of blood from the right auricle into the inferior vena cava and hepatic vein, in cases of tricuspid incompetency. A murmur may sometimes be heard in the epigastrium. Usually this is a conducted cardiac murmur, but occasionally it depends on an aneurism.

FREDERICK T. ROBERTS.

EPIGLOTTIS, Diseases of. *See* LARYNX, Diseases of.

EPILEPSY (ἐπιλαμβάνω, I seize upon).—SYNON.: *Morbus comitialis, sacer, major, &c.*; Fr. *Épilepsie, haut mal, &c.*; Ger. *Fallsucht.*

DEFINITION.—An apyretic nervous affection, characterised by seizures of loss of consciousness, with tonic or clonic convulsions.

Of these two features—muscular spasms and loss of consciousness, neither is alone sufficient to establish the existence of epilepsy. Still, each of these two kinds of symptoms, when occurring in the form of an attack, is an *epileptiform* manifestation, as we find that patients who generally have convulsions only, are sometimes simultaneously seized with unconsciousness, and *vice versâ* that in those very rare cases in which patients are attacked only with loss of consciousness, without any marked spasmodic action of any muscle, there are sometimes complete fits of epilepsy. The relationship between the two essential characteristics of epilepsy was well exemplified in the cases of two patients who were placed under the writer's care in London, in 1860, by his lamented friend, Dr. W. Baly. These patients, who were brother and sister, were both incompletely epileptic: one had only attacks of convulsions, the other only attacks of loss of consciousness. Their father had been completely epileptic, and one of these two young patients had inherited one aspect of the disease, the other the other aspect.

Efforts in two absolutely opposite directions have been made to modify the significance of the word *Epilepsy*. Some writers give that name only to the special affection which others call *Idiopathic Epilepsy*. Other physicians have considered as belonging to epilepsy, most if not all of the non-febrile affections consisting in attacks of aphasia, of amaurosis, of paralysis, &c., or of disordered involuntary movements (choreic, tremulous, rotatory, &c.). There is no doubt that all apyretic nervous affections, appearing in seizures, have in that feature a common link with epilepsy, and it would be important to have a name for that group of paroxysmal neuroses. But the word epilepsy must remain for the special morbid manifestations that we have mentioned. As regards the application of the word epilepsy to those cases only in which no organic disease either of the nervous centres or other organs can be looked upon as a cause of that convulsive affection, neither the symptoms, nor the prognosis, nor the principal rules of treatment, show that we must entirely separate the idiopathic from the other kinds of epilepsy. It is, however, important, as will be shown hereafter, to try to find out, in every case of epilepsy, whether this convulsive affection is of the kind we call idiopathic, or proceeds from a peripheric or central organic lesion or irritation, or from some alteration of the blood.

PATHOLOGY.—Under this head it is only necessary to give an idea of the state of the nervous system that seems to exist in epilepsy. As early as 1857, the writer, in his work on this affection, showed that it essentially consists in an increased excitability of certain parts of the nervous system. This augmentation of excitability may exist only in the cerebro-spinal centres, or partly there and partly also in some peripheric parts of the nervous system. The analysis of phenomena when epilepsy is gradually produced in animals leads forcibly to that view. We find in these animals, that, after a few days have passed from the time of the lesion which causes epilepsy (either a section of the sciatic nerve or of a lateral half of the spinal cord, in the dorsal region), the first change manifested consists in an increase of the reflex power of certain parts of the skin of the face and neck, while a greater excitability takes place in the medulla oblongata, in the upper part of the cervical region of the spinal cord, and in some parts of the trigeminal and of the two or three first cervical nerves. Gradually the reflex excitability of the nerve-cells in direct communication with the fibres of the nerves we have named increases, so that the irritation of the skin of the face and neck, instead of producing only, as at first, a reflex contraction of the neighbouring muscles, causes a tonic spasm of all the muscles of the trunk, neck, and head, on the side of the lesion and of the irritation. Later on the reflex spasmodic action extends to the other side, and at last a complete attack of epilepsy (a month or later after the traumatic injury which acts as a cause) supervenes, characterised, as in man, by loss of consciousness, with tonic or clonic convulsions. In cases of injury to certain parts of the base of the brain in some animals, the same changes may take place, but with two differences: 1st, the rapidity of increase in the reflex excitability of the parts above-named is very much greater than after an injury to the spinal cord or to the sciatic nerve; 2ndly, the zone of skin that acquires the power, when irritated, to give rise to an attack, is on the opposite side to that of the brain-injury, while it is on the corresponding side to that of the lesion of a nerve or of the spinal cord.

Want of space prevents the writer from giving the many reasons which show that what takes place in animals rendered epileptic by the lesions mentioned, applies in a great measure to the production of epilepsy in man. It will suffice to state that there are abundant facts which tend to establish the conclusion that in all nervous affections in which there are seizures, attacks, or fits of any kind, the essential feature is a morbid increase of the reflex excitability, while the differences between the various symptomatic manifestations depend on what nerve-cells are altered in their vital properties. In other words, we would say that, although there is the same morbid change, there are epileptiform, choreic, amaurotic, paralytic, aphasic phenomena, according to the particular nerve-cells in which that change takes place.

Nothing has resulted from the efforts that have been made to establish the theory that epilepsy depends on disease in any part having a special name in the nervous centres. The so-called *seat of epilepsy* has been successively placed in the cere-

bellum, the cornu ammonis, the pons Varolii, the medulla oblongata, the convolutions of the brain, &c. There is just as much reason to place that seat in those parts, as there would be to place it in the mucous membrane of the bowels or in the sole of the foot, or in any peripheric part of the nervous system, where an irritation is found causing epilepsy. In cases such as these last, as well as in the preceding, the very same things occur; an irritation starts from the place where we find an organic lesion, and proceeds to nerve-cells in the base of the brain and in the upper part of the cord (or in one of those parts alone). Through this irritation those nerve-cells have their nutrition altered, and after a time they acquire that morbid excitability which is the essence of epilepsy. We do not think it will ever be possible to recognise what cells are altered, as it is quite likely that the change in them is more dynamical than physical, and that no more microscopical differences could be detected between two of them, one normal and the other possessing great morbid reflex power, than there are visible differences between two pieces of magnet—one poor, the other rich in magnetic power.

The true seat of epilepsy therefore is in nerve-cells, having the power of producing morbid reflex muscular contractions; but the location of these cells must be variable, as is shown by the fact that the first symptom of an attack may be in the most different parts of the body. That these cells are located chiefly in the base of the brain is a conclusion borne out by many facts. But as we have ascertained, experiments on animals show that the very same kind of epileptiform convulsions can take place after an irritation of the skin, whether the nervous system is left entire or diminished notably by the ablation of the brain and cerebellum, and also of the pons Varolii and part at least of the medulla oblongata. The spinal cord has therefore a share in the production of epileptiform convulsions, and as we know that it can, in man as well as in animals, arrest the activity of the brain under some stimulation, we may easily admit that it may help in producing in man an arrest of cerebral activity during a fit of epilepsy.

Ætiology.—*Heredity* deserves to be noticed first in this respect, not because it is the most frequent, but because it is a most undeniable cause. If we canvass what has been said by many writers on the subject of the heredity of epilepsy, we find that most statistics published do not give sufficient details to enable us to ascertain what are the morbid states of the brain in a parent which can cause epilepsy in the offspring. Pritchard has justly shown that all neuroses have the greatest relationship one to another. It is but natural, therefore, that epileptics are very often found to have had a father or a mother attacked with some nervous disorder. Moreau has shown that epileptics often have insane persons as their parents. If we put together those three groups of affections—organic disease of the brain, neuroses, and insanity—we find that epilepsy will often exist in the offspring of people who have been attacked with an affection belonging to one of those three groups.

As regards the influence of *sex*, we believe that there is a marked difference among women and men of somewhat advanced age, the proportion of women being larger than that of men; but this is not the case, and it is even in some degree the reverse, for people under twenty-five years of age.

Age has certainly, independently of sex, a decided influence on the appearance of epilepsy. The following table given by Hasse is important, as it is the most extensive. It agrees fully with the results of the writer's own observation:

Age at commencement	No. attacked
Congenital	87
Under 1 year of age	25
From 2 to 10	281
„ 10 „ 20	364
„ 20 „ 30	111
„ 30 „ 40	59
„ 40 „ 50	51
„ 50 „ 60	13
„ 60 „ 70	4
	995

It is difficult to say at what age hereditary epilepsy is most prone to make its appearance. The writer's experience seems to show that it is between ten and twelve in boys as well as in girls. It is certainly by far more frequent to find that inheritance manifests itself before than during the period of change that puberty causes. Romberg, Dr. Russell Reynolds, and several other writers have already pointed out that such is the general rule.

Is puberty itself a cause of epilepsy? This is clearly proved by the large number of epileptics who, as shown in the preceding table, have been attacked between the ages of ten and twenty (364 out of 995).

Of other causes the most powerful are not those usually stated. In patients under fifteen years of age the most frequent cause after heredity is some more or less obscure alteration of nutrition of the brain, or congestion of that organ or of its membranes, remaining a more or less considerable time after typhoid fever or scarlatina. It is frequent, indeed, that in examining such patients (even when there are reasons to believe in heredity), there are a number of symptoms showing some deficiency in the action of the brain, as regards its motor, sensitive, or sensorial functions. It is most important to detect those symptoms (and they are so slight generally that they would not be noticed if not most carefully looked for), as the form of epilepsy, due to or allied with the cerebral alteration which then exists, is often curable, or at least can be considerably benefited by treatment.

Of the different ætiological factors we have mentioned—heredity, age, puberty, sex, fevers—none but heredity can be looked upon as a real and direct cause of the form of epilepsy which is called idiopathic. The other factors only give origin to predisposing conditions; excepting fevers, which can do more, as they may cause diathetic, sympathetic, or symptomatic epilepsy.

Purely *psychical* and *emotional* causes seem to be by far less frequent than has been supposed. They act chiefly, if not only, as means of bring-

ing on attacks in persons more or less ready to have them.

If idiopathic epilepsy be set aside, we find that the ætiology of the other forms of that affection is much more easily found out, and that almost always the cause is some recognisable irritation of a part of the nervous system. Diseases or injury of any part of the trunk and limbs or of the viscera; diseases or injury of any part of the cerebro-spinal centres or of their meninges, often produce epilepsy. The mucous membrane of the bowels and the cerebral meninges are the parts most capable of giving rise, not only to simple convulsions, but also to sympathetic epilepsy. Among the various organs constituting the encephalon, those having the greatest power of giving rise to symptomatic epilepsy are the optic thalami and the convolutions, especially those of the parietal lobes. But it would be quite wrong to conclude from the facts recently discovered by Fritsch and Hitzig, in their experiments on dogs and other animals, that certain parts of the cortex cerebri, near the fissure of Rolando, are much more connected with epilepsy than any other. The truth is that that neurosis can be caused by a disease of, or an injury to, any part of the cerebro-spinal centres: the anterior, the posterior, as well as the middle lobes, the base of the brain as well as the cerebellum or the spinal cord.

Sympathetic epilepsy is very frequently due to an irritation of the sexual organs, especially brought on by masturbation. In Anglo-Saxon countries, where children of the two sexes are less watched and less warned against the dangers of that fatal habit than in other civilised countries, epilepsy due to that cause is particularly frequent.

Alterations of *blood*, in quantity or quality, are certainly favourable circumstances, if nothing more, in the production of epilepsy. As regards the experiments of Kussmaul and Tenner, we will say that although a rapid and considerable loss of blood can cause an epileptiform attack, it has not been shown that such a cause has produced epilepsy. It is nevertheless true that anæmia is a very frequent factor in the causation of epilepsy or any other neurosis. A weak and slow action of the heart also is found in a number of cases to be among the causes of epilepsy. But the reverse is sometimes observed; and we have not rarely seen cases of epilepsy in which the pulse was strong and beating more than 100 times a minute, without any disease of the heart or of any other organ, that could account for this great activity of circulation. In these cases the only morbid condition that could be looked upon as a cause of epilepsy was the abnormal circulation. In a case of this kind, placed under the writer's care by Sir Thomas Watson, the patient was rapidly benefited by treatment, and has had no more attacks since 1863, so that that kind of epilepsy is sometimes curable, as is the form due to anæmia.

Whether epilepsy due to syphilis or to Bright's disease, or to affections of the liver, is ever produced in a direct way, and exclusively by some alteration of the blood, is not yet established; but it is certain that, especially where there exists one of the two last causes just mentioned, the state of that fluid has a notable share in the production of the neurosis. But other ætiological factors then exist: an irritation of the nerves of the kidneys, or of the liver, or of the meninges, and some alteration of structure of blood-vessels or of other parts of the brain, or sometimes a morbid deposit in the encephalon, or its membranes.

Symptoms.—We shall consider this part of the subject under three heads:—the *premonitory*, the *paroxysmal*, and the *inter-paroxysmal* symptoms.

1. *Premonitory.*—The frequency of premonitory symptoms, according to the writer's experience, is much greater than is generally known. It is extremely important to find out the existence of these warnings, as in many cases attacks may easily be prevented if we know when they are on the point of taking place. When we say that premonitory indications are extremely frequent, we do not mean that the classic or *Galenic aura* is often found. That vague, queer, and unexplained sensation, whether accompanied or not by a muscular contraction, is certainly more frequent than is admitted, but is by far less often observed than the other kinds of warnings. Among the premonitory symptoms, there are four oftener observed than others:—one is a change of temper (irascibility appearing or increasing); another is a vascular contraction in the feet or hands, producing a diminution of temperature; and the two others a spasmodic state of some muscle, or an optical illusion or hallucination. It is impossible to sum up the various manifestations which indicate that an epileptic attack is forthcoming. Alterations of the various functions of the brain, sensations of all kinds, headache or backache, vertigo, sensorial disturbances, sleeplessness or sleepiness, palpitation, dilatation or contraction of blood-vessels anywhere, altered breathing, diminution or increase of the various secretions (of the skin, mucous membranes, or of the visceral glands), hæmorrhages from the nostrils or other parts, fever, more or less marked weakness (general or local), hunger or thirst, disgust for food or drinks, sexual appetite or the diminution or loss of sexual desire or power, erection of the penis, spasm of the bladder, sometimes with involuntary evacuations of urine, involuntary expulsion of fæces, cramps, trembling, choreic movements, tendency to run forwards, backwards, or round, rigidity or convulsions of a limb or other parts, paralysis of a limb or other parts, etc.,—such is an abbreviated list of the forerunners which have been noticed by a number of observers, and all of which we have seen, or have been found in our patients.

Sometimes one or several of these symptoms will appear a day or two before the attack, but generally the warning shows itself a few hours, or a very much shorter time (even only a few seconds or a minute or two) before the seizure. In cases of epilepsy due to organic cerebral disease, or to cerebral congestion (much more rarely in other cases), there occurs rather frequently, either during the attack or before it, drawing of the head towards one shoulder. If this occur before the loss of consciousness it is a most valuable warning, as it is then almost always possible to produce an abortion of the

attack. Premonitory symptoms unfortunately are sometimes deceptive, as they may appear more or less frequently without being followed by the attack; and in cases in which warnings usually precede the seizures, there are sometimes attacks without any forerunner.

2. *Paroxysmal.*—As regards the paroxysmal symptoms, they vary considerably according to the kind of attak. If the attack is one of *petit-mal* (*epilepsia mitior*), there may be no other symptom than a loss of consciousness, with either a fixed state of the muscles of the eye, or a slight contraction of one or more muscles of the face or neck, or a movement of the lips, tongue, and throat, as in the act of swallowing. If we spoke according to our personal observation, we should affirm that an attack of *petit-mal* never consists in a loss of consciousness only, without the least trace of any other trouble whatsoever. Dr. Russell Reynolds, however, states that he has seen such attacks, and therefore we must admit that sometimes a pure and simple loss of perception and volition is all that exists in a seizure of epilepsia mitior. In such an attack the patient may, if walking, continue to walk, but if talking, he stops—generally for so short a time, however, that the trouble may pass absolutely unnoticed by listeners. Usually an attack of that kind lasts only from one to four or more seconds.

An attack of complete epilepsy (*epilepsia gravior*) is a very complex series of phenomena. Years ago (in 1857) the writer gave the following table, which shows at the same time in what order and by what mechanism the symptoms appear. Only on a few points has he to alter the views held twenty years ago. It will be seen that in this table the effects successively produced become causes in their turn.

CAUSES.	EFFECTS.
1. Excitation of certain parts of the excito-motor organs of the nervous centre.	1. Contraction of blood-vessels of the brain and face; tonic spasm of muscles of the eye and face.
2. Contraction of the facial blood-vessels.	2. Facial paleness.
3. Contraction of the blood-vessels of the cerebral lobes.	3. Loss of consciousness; congestion in the base of the brain and the spinal cord.
4. Extension of the excitation in the excito-motory organs of the nervous centre.	4. Tonic contraction of the laryngeal, the cervical, and some respiratory muscles (laryngismus and trachelismus).
5. Tonic contraction of some respiratory and vocal muscles.	5. Epileptic cry.
6. Further extension of the excitation in the excito-motory organs.	6. Tonic contraction reaching most muscles of trunk and limbs.
7. Loss of consciousness alone, or with tonic spasm in trunk and limbs.	7. Fall or precipitation, forward or backward, to the ground.
8. Laryngismus, trachelismus, and rigid spasm of some respiratory muscles.	8. Insufficient breathing; obstacle to entrance of blood into the chest, and to its issue from the cranio-spinal cavity.
9. Insufficient breathing; rapid consumption of oxygen, and detention of venous blood in the encephalon.	9. Increasing asphyxia.
10. Asphyxia and perhaps pressure by accumulated venous blood in the base of the brain.	10. Clonic convulsions everywhere; contractions of the bowels, the bladder, the womb; increase of secretions; efforts to inspire.
11. Exhaustion of the nervous power generally, and of the reflex excitability especially; return of regular respiratory movements.	11. Cessation of the fit; coma or fatigue; head ache; and sleep.

Space does not permit of our insisting on the explanations given in this table. We will only say that the loss of consciousness is too rapid, too complete, to be due only or chiefly to a contraction of the blood-vessels of the cerebral lobes. In that case, as well as in cases of loss of perception and volition from a hæmorrhage, a softening, or some other disease of the brain, it is owing to an *inhibition* of the activity of cerebral nerve-cells that this symptom appears.

We will add to the above-given list of symptoms that besides the sudden loss of consciousness, with tonic spasm of the muscles of the eye, face, neck, chest, and limbs, and the uttering of a loud cry, which we observe in the beginning of a complete attack of epilepsy, there is sometimes biting of the tongue or lips. After the first stage, which is usually extremely short (not lasting generally more than from 10 to 20 seconds), general clonic convulsions appear, the face becomes more or less violet or purple, the temperature of the body rises, the skin becomes covered with perspiration, and saliva, reddened by blood or not, flows out of the mouth.

After the cessation of the convulsions, the patient is often so exhausted that the limbs fall, if lifted up, as if they were quite paralysed; the respiration is stertorous; and the heart beats with great force and rapidity. If care be not taken to have the tongue brought forward, and if the head be not placed on one side, the heavy breathing and the comatose state which often exist, continue for a long time. Even if care be taken about the position of the tongue, these disturbed states of the brain and breathing may last an hour or longer, in very bad cases. In some epileptics who have a series of fits in rapid succession, there is a more or less prolonged period of coma after each attack. Sometimes in such cases death terminates the scene after a more or less considerable number of attacks.

On waking up either from the coma or the

sleep following an attack, most patients are very tired; their limbs and trunk aching as well as their head. Usually there is some mental alteration, often consisting of confusion or stupor, and sometimes delirium. The mind, however, may be quite clear, even after a violent attack, and the head free from pain, the only effect of the fit being general lassitude. On the contrary, after an apparently slight seizure, there is sometimes considerable mental disorder. The degree and duration of stupor after an attack have no relation to the duration of the convulsive period. Stupor is an effect of asphyxia and is, therefore, in direct relation with laryngismus, trachelismus, and the spasms of the thoracic muscles, of the diaphragm, and perhaps of the bronchial tubes also. It has been stated and denied that the urine passed after an attack of epilepsy sometimes contains albumen, in patients free from kidney-disease. In at least two cases the writer has ascertained that there was a notable amount of albumen in the first issue of urine after attacks in which there had been violent spasmodic contractions of the abdominal and thoracic muscles. These two patients afforded no evidence of disease of the kidneys or of the heart.

Attacks of epilepsy are sometimes very slight, consisting only, besides the loss of consciousness, of an extremely short tonic spasm of muscles of the trunk, the neck, the head, and the limbs. But even in the shortest and slightest attack of that kind the epileptic cry may be uttered and the tongue may be bitten.

The symptoms of a seizure of epilepsia mitior (*petit-mal*) are very different from those of a violently convulsive attack of epilepsy (*haut-mal*). The loss of consciousness occurs only for one or a few seconds, and the spasmodic contractions take place in a few muscles only, in the face, tongue, throat, eyes, and neck. If seized while standing up the patient very rarely falls, and on the contrary, if walking, he may continue his movement as regularly as before the fit. If attacked while speaking, he stops while the consciousness is lost, and on recovering it he may complete the unfinished sentence, so that the bystanders may know nothing of what has occurred. Sometimes, however, the patient's mind is deeply altered, even when the attack of petit-mal has been as short and slight as possible.

Nocturnal attacks of epilepsy may occur without any knowledge of their having taken place. Indeed, the writer has sometimes been consulted by persons who only asked for advice on account of headaches, and who had no pain in the head except after nocturnal attacks of epilepsy occurring without their knowledge. In such cases the patient, after a seizure during sleep, wakes up tired, as if he had walked considerably; he has pains in the limbs, the back, and the head. He finds his mind confused, and his memory affected; he feels disinclined to get out of bed or to exert himself in any way; and he often is excitable or depressed. Sometimes his tongue or his lips are sore, and if the pillow is examined it shows bloody spots. More rarely it is found that an involuntary evacuation of urine has soiled the bed. Anyone sleeping within hearing distance of the patient may be wakened by the piercing epileptic cry, and then hear the noise of the shaking of the bed, caused by the convulsive movements. Such attacks, although very frequent and also very violent, may remain altogether unknown and unsuspected by the patient and his friends.

3. *Inter-paroxysmal.*—The general health of epileptics is usually very poor. Besides the alterations of their mental powers, and especially of their memory, they show a great deal of excitability and often depression of spirits. Their circulation and their digestion are often affected. There is nothing special to them, however, either in the morbid state of their mind and of their feelings, or in the disturbances of their physical health. We do not consider the mental aberrations observed in the inter-paroxysmal state as elements in the symptomatology of epilepsy. These aberrations can exist without epilepsy, and in a great majority of cases epilepsy is unaccompanied by them.

The frequency of attacks varies immensely in epilepsy. In one case the writer learned that for more than seventeen years the patient had passed no night without a fit, and for more than ten years the average nightly number of fits had been about twelve, which gives a total of more than forty thousand attacks in ten years. On the other hand, he was once consulted by a patient, sixty-two years old, who has had but seven attacks since the first occurred, forty-three years ago, the interval between that and the second fit having been thirteen years, and the interval between the two last seizures having been seven years. Between extremely different cases like the two just mentioned, we find the greatest variety as regards the frequency of attacks. Usually, however, there are a number of fits every month. If there are attacks with extremely violent convulsions, the frequency is generally much less than when the convulsions are slight. Seizures of *petit-mal* are usually very frequent. A perfect periodicity is extremely rare, but an approximation to periodicity is not rare, especially in women. Singular and inexplicable periods will sometimes exist; the writer knows of a number of cases with a weekly periodicity, and of a case in which for years attacks recurred every forty-nine days.

Diagnosis.—In most cases it is easy to distinguish epilepsy from the few affections which resemble it. Sometimes, however, difficulties exist. There is no essential difference between the attacks of eclampsia in women and children and attacks of epilepsy, except the existence in eclampsia of a peripheric cause of irritation, which is likely to disappear. But those purely reflex epileptiform attacks of women and children are sometimes succeeded by genuine attacks of epilepsy, changes in the nervous centres occurring during the eclamptic attacks, which lay the foundation of persistent epilepsy, showing itself after the peripheric irritation, which was the first cause, has ceased to exist. It is sometimes, therefore, almost impossible, in children especially, to say if we have to deal with eclampsia or epilepsy. The same may be said of all kinds of attacks of loss of consciousness and convulsions due to a peripheric cause, whether we call the affection eclampsia or reflex epilepsy. (*See* Convulsions.) The first cause in those cases may

cease to exist without our discovering positively that it has disappeared, and still attacks may continue. As the treatment is to be very much the same, except that in purely reflex epilepsy we have to fight against the peripheric cause besides making use of means against epilepsy itself, a mistake is not dangerous.

Hysteria sometimes borders on epilepsy, so much so that we must accept for certain groups of nervous symptoms, the name of hystero-epilepsy. Usually, however, there is no complete loss of consciousness in hysteria: there is rather a disordered consciousness. The convulsions generally do not follow the ordinary cycle of those of epilepsy: they are not merely tonic first and then clonic; they often are alternately, and many times successively, clonic and tonic. They sometimes resemble voluntary movements rapidly executed. The attack is not followed by the stupor that follows so often a fit of epilepsy. Before and after the attack, the patient exhibits (or has done so) purely hysterical symptoms. Usually, pressure on the ovary during the attack stops or increases it, while nothing of the kind is found in a fit of epilepsy, except, of course, one of hystero-epilepsy, in which case the two affections are blended in one.

Epilepsia mitior (*petit-mal*) sometimes cannot be easily distinguished from syncopal attacks. Usually, however, the pulse does not lose so much in frequency and force in *petit-mal* as it does in fainting. The loss of consciousness lasts for a shorter period in *petit-mal* than in syncope.

Between idiopathic epilepsy and cerebral epilepsy, there are generally very marked differences. In epilepsy due to disease of the brain, attacks are almost always preceded by an aura, consisting either in referred sensations or in cramps; in such attacks, convulsions often occur without loss of consciousness; very frequently the convulsions are unilateral, either on the paralysed side or on the other side; and almost invariably, if they are not clearly unilateral, differences in intensity, in kind, and in duration exist as regards the spasmodic contractions between the two sides of the body.

Prognosis.—Inherited epilepsy is very rarely cured. The writer can positively state, however, that it may be cured. Among other good cases of persistent cure, he has seen two extremely remarkable. The patients were first cousins, and had inherited the disease from a grandmother: one of them died from a fall while intoxicated, five years after his last attack of epilepsy; the other died in China, from typhoid fever, seven years after his last attack. They had both been treated for about two years, in 1852 and 1853.

There is a very great difference as regards prognosis between pure idiopathic epilepsy and other forms of that neurosis. The chances of cure, although never great, are by far greater when some curable or amendable organic alteration exists, as a cause of epilepsy, than when no such thing exists. One form of this nervous affection—that which is due to some congestion or even a more serious alteration of the brain, —consecutive to typhoid fever, scarlatina, or measles, is very often much benefited by treatment, if not cured. Epilepsy caused by disease of the brain—syphilitic or not—is much more curable than any other form of that neurosis. Epilepsy beginning in childhood, from teething or a bowel-complaint, and having lasted many years, is almost incurable.

Complications and Sequelæ.—Epilepsy has no necessary or usual complication. The diseases which accompany it often are frequently its causes and not complications. Bright's disease and other organic affections of the kidney, diseases of the liver, the womb, and other viscera, when allied with epilepsy, if they have not been the first and only cause of it, are powerful additional causes. There are no sequelæ of epilepsy worth mentioning except some amnesia, which we invariably find in patients cured of that affection, after having suffered from it for many years.

Treatment.—A most important fact ought at first to be pointed out under this head: it is that as every attack causes in the nervous centres changes which prepare other attacks, it is essential to produce, if possible, the abortion of attacks whenever warnings occur. The treatment to obtain such an abortion varies with the kind of warning. In cases in which a real aura exists many means can be employed with the greatest benefit. The writer long since showed that the old-fashioned mode of prevention of attacks, consisting in the application of a ligature round a limb, acts not as the Galenic doctrine supposed that it did, that is, by barring the way to something going up to the brain; but, on the contrary, in doing just the reverse, that is, by sending an irritation towards or rather to the nervous centres. The writer has also shown that the ligature need not be left applied, and that a greater success is obtained by tying suddenly and very quickly a handkerchief or a band, and repeating this tying several times in succession, than by applying the ligature even very tightly and leaving it so. He has also demonstrated:—1st. That the ligature can do good even when applied on another limb than that where the aura is felt, although it is usually more efficacious on the latter; and 2nd. That pinching or striking the skin, or irritating its nerves by heat, by cold, by galvanism, or by repeated pricks with a needle, will generally do as much good as the ligature.

In those cases in which an involuntary muscular contraction takes place before an attack—that is before the loss of consciousness—one of the most efficient means to produce an abortion of the fit is to draw forcibly on the contracted muscles, so as to elongate them. For instance, in those cases in which the unconsciousness is preceded by a contraction of the muscles of the neck, drawing the chin towards one shoulder, turning forcibly and rapidly the head towards the opposite shoulder, gives in most cases a very good chance of checking completely the tendency to the fit. In case of contraction of the flexor muscles of the forearm, forcible extension of the hand over the fore-arm may succeed in preventing the attack. A blow, pressure, or friction on parts where some muscles become rigid, may have the same favourable effect.

If there are disturbances of breathing among the premonitory symptoms, the inhalation of ether or chloroform may prove successful. In

cases of laryngismus similar means, or the cauterisation of the fauces by a strong solution of nitrate of silver has been found most useful by the writer. The use of anæsthetics as a means of warding off an attack is too much neglected. By the help of ether in inhalations we have succeeded, with Mr. R. Dunn, in preventing an attack in a patient who had had a fracture of the arm in a previous seizure, and who used to have a fit regularly every week. A whole week was gained in that way. In some cases the recurrence of attacks has been warded off by giving chloroform or ether (by inhalation) to patients who had had the first of what would have been otherwise a series of many fits. There is, in cases in which a fit is expected, a considerable chance of preventing it by etherisation or chloroformisation.

According to the kind of warning and to its seat one means or another out of a very large number (only some of which we shall mention), ought to be used. An emetic, a purgative, a stimulant, the immersion of the two hands in hot water, the application of a lump of ice to the back of the neck or between the shoulder-blades, the subcutaneous injection of a solution of $\frac{1}{40}$ of a grain of atropine with $\frac{1}{3}$ of a grain of morphine, powdered *asarum* taken as snuff, a dose of 25 grains of hydrate of chloral, the inhalation of a small dose of nitrite of amyl, extremely rapid and ample voluntary respiratory movements for five or six minutes, jumping, running for at least ten minutes, reading very loud and fast—such are some of the means which we have found to be the most successful.

The second point of importance about treatment is to try to discover a part of the body which can by irritation give rise to a premonitory symptom of an attack, or even to an attack itself. If such a part is discovered, counter-irritation of some kind is to be applied there. Our remarks must be confined to saying, that hard pressure on certain parts of the head, the spine, the breast, the abdomen, or the limbs, has in a number of cases produced an attack or some symptoms of it. We have seen the passage of a galvanic current produce the same effect. In such cases a blister or other local application has done good in diminishing the violence or frequency of attacks, and even, in a few instances, helped notably to a cure.

The modes of treatment of epilepsia gravior or mitior which chiefly deserve to be noticed are the following:—

Against idiopathic epilepsy the most powerful means consists in the simultaneous use of some tonic remedy (such as strychnine or arsenic) in a solution to be taken after meals; and of a mixture composed more or less like the following:—

℞ Potassii iodidi, ʒij.
Potassii bromidi, ʒj.
Ammonii bromidi, ʒiij.
Potassæ bicarbonatis, ʒj.
Tinct. calumbæ f. ʒj.
Aquæ destillatæ f. ʒvj.

Of this solution may be given to adults four doses a day, three of one teaspoonful each before meals, and the fourth of three teaspoonfuls at bed-time with as much water as desired. According to many circumstances the dose of one or another of the ingredients is to be changed. For example, if the *petit-mal* exists alone, or coexists with the complete epilepsy, the dose of the bromide of ammonium must be larger, and that of the other bromide diminished. If there is a weak pulse the sesquicarbonate of ammonia is to be substituted for the bicarbonate of potash In the writer's work on functional nervous affections all the rules relating to that mixture are given, and we will only say now that its use is by far more beneficial than that of any of its ingredients alone or of two of them. Two essential rules are to be followed when either such a mixture or any of the many bromides is employed against epilepsy; the first is, that there ought to be no interruption whatever in the use of such remedies, as the whole benefit that may have been obtained may be lost at once after an interruption of even only a few days; the second is that the treatment must be persevered with for at least two years after the appearance of the last attack. There is no marked harm in the great majority of cases from a prolonged use of a mixture like the above; many patients have taken it for several years, and some for six, eight, or ten years without any marked bad effect.

Idiopathic epilepsy (either the complete or the incomplete, that is the *petit-mal*) has been successfully treated (very rarely cured, but often benefited) by the use of a number of remedies. Judging by his own experience, the writer names, as the most powerful, atropine and the ammoniated sulphate of copper. Although not able generally to produce as much and especially as prompt a good effect as the above mixture, these two remedies have the superiority over this mixture that they need not be constantly used, and that there is no necessity of continuing to employ them longer than eight or ten months after the last attack. Next in importance after the three means spoken of, will come the cotyledon umbilicus, the nitrate of silver, and zinc preparations, especially the bromide of zinc.

The other forms of epilepsy require pretty much the same modes of internal treatment; but, of course, according to the cause of each form some special means should be employed. In the above prescription the dose of the iodide of potassium must become as large as that of the bromide of potassium, when syphilis is considered to be the cause of epilepsy, and, if needed, mercury should be administered also. If epilepsy depends on some visceral affection it is clear that the treatment should be directed against that affection. But if the liver is diseased from some influence of malaria the sulphate of quinine should not be given, as it is almost always a bad remedy against epilepsy, often more hurtful than it can be useful. Arsenic then should be the remedy used against the sequelæ of fever and ague. If quinine must be employed in cases of clearly periodical epilepsy, the valerianate should be given rather than the sulphate.

It may seem strange that we do not name iron among the remedies against epilepsy. The writer's experience shows that in most cases iron is rather harmful than useful. It is only in cases of epilepsy allied with or caused by chlorosis or considerable anæmia that its good effect is often

very marked. Even then, we have sometimes found manganese more serviceable. There is, however, one salt of iron—the citrate—which, although less powerful against a deficiency of blood-globules, is however less apt to give rise to attacks than are most ferruginous preparations in a number of cases.

Of other internal remedies, cod-liver oil if well borne is certainly useful, especially against the *petit-mal*. The importance of giving simultaneously with the bromides either arsenic or strychnine has been already mentioned. Arsenic alone can do much against any form of epilepsy, perhaps chiefly against *petit-mal*, but the writer does not personally know of a single case of cure by its use. Strychnine can also alone do good, but less than arsenic. Digitalis or digitaline have been credited as having effected cures; so have turpentine and a number of other medicines. The writer has obtained only a very limited good from the use of digitalis or turpentine. As regards the curative influence of the nitrite of amyl, it is yet *sub judice*.

From counter-irritation there is a great deal to be expected. Ice (not in a bag) the actual cautery, blisters, &c., applied to the back part of the neck and between the shoulder-blades, are most useful in any form of epilepsy, especially when there is a great deal of headache and considerable heat in the head. When attacks are very violent and frequent, there is some good, and at times a decided amelioration to be obtained from croton oil applications on a great part of the shaved head. Setons and issues very rarely do any good, and often weaken and irritate.

A circular blister round a limb, a finger or a toe, is most useful in cases of an aura starting from those parts. It is known that in such cases a nerve has been divided, sometimes with great success. Of more serious operations, there is one which ought to be completely rejected, unless there is good reason to suspect the existence of an intracranial aneurism on the carotid artery or one of its branches, namely, the ligature of that artery in the cervical region. Although beneficial in a few cases it is a dangerous operation, and much inferior to many other means of treatment. Trepanning the cranium, except on clear, rational ground, is certainly to be avoided, although it has in a few such cases cured or ameliorated the condition of the patient. But when the attacks are extremely violent and frequent, especially if they seem to endanger the life of the patient, and when there is a clear evidence of pressure exerted on the brain, that operation, which in such cases has often been useful, ought to be resorted to, after the failure of other means. Laryngotomy or tracheotomy are to be rejected, except in those instances in which the operation would have to be performed even if there were no epilepsy. In cases of laryngeal epilepsy the writer has found the cauterisation of the fauces and of the larynx itself with a strong solution of nitrate of silver a very useful means, and even in one case a means of complete and persistent cure.

During an attack of epilepsy, excepting what simple common sense suggests, there is very little to be done. Pressure on one or on both carotid arteries, which we now know to act on account of the accompanying pressure on the par vagum and on the cervical sympathetic nerves, will sometimes considerably shorten an attack, especially if there is violent action of the heart. At the time convulsions cease, the tongue ought to be drawn forward and the head of the patient, if not his body, turned sideways, so as to avoid the covering of the larynx by the half-paralysed tongue. No other interference at all with the patient should be the rule after the attack.

C. E. Brown-Séquard.

EPILEPTIFORM } .—Partaking of the characters of epilepsy; terms generally applied to convulsions. *See* Convulsions.

EPILEPTIC INSANITY.—The different classifications of mental diseases agree generally in making a separate division of the intellectual derangement related to epilepsy. This latter ranks prominently among the predisposing causes of insanity, but has not been found to proceed from it, unless the epileptiform convulsions observed with the majority of mental affections be improperly regarded as epilepsy. Evidently, the fits of *petit mal* are associated with insanity more frequently than even the most violent of *grand mal*; however, from this association it does not necessarily follow, as currently believed, that insanity should be a mere consecutive accident of the fit. Falret, endeavouring to reconcile the views on the subject put forward by French alienists, asserts that insanity chiefly occurs as a consequence of epileptic attacks recurring at short intervals after a prolonged suspension of the disease—which is very true. Yet, insanity may besides break out after nocturnal attacks, or seizures of *petit mal*, without any relation whatever to the length of their suspension, or number; and mania—usually of the most furious character—may also appear as a forerunner instead of the sequel of the fit; or it may originate with the very first epileptic seizure and recur continually thereafter. Lastly, the existence of epilepsy and paralysis brings about, from the beginning, a gradual though obvious impairment of the intellectual faculties, which becomes exacerbated by the fits, and terminates in dementia. No less open to objection is the kindred nature of the physical and psychical manifestations of epilepsy, admitted by Falret, to establish thereupon the *intellectual petit mal* and the *intellectual grand mal*. The first correspond with the incoherent and violent state described as furious mania. The second may continue from several hours to several days, constituting an intermediate condition between the irregularities of character which attend the fit, and the highest disturbance of the furious maniacal seizures. In the midst of this confusion of mind epileptics recall to their memory the painful past impressions, which spontaneously spring up in their imagination, always the same at every new access, and give themselves up to instantaneous, sudden acts of violence. After such fit of violence, the epileptic either quickly returns to himself, regaining his consciousness and rendering an imperfect account of his misdeeds, or, on the contrary, he escapes, running away in a

bewildered and greatly agitated condition. In either case the confusion, if not the complete oblivion of what has happened, is almost always a striking essential feature of this mental state, so much resembling the awakening from a dreadful dream. The foregoing phenomena are, indeed, exhibited by the insane epileptic; but the distinction between the *intellectual grand mal* and the *intellectual petit mal*, and their respective reference to the physical paroxysms of epilepsy, supposed by Falret, implies an essential connection which is far from being constant. The most fearful fits of rage, or frenzy, may follow the *petit mal*, or may burst out without any visible attack at all, while nocturnal fits, or *petit mal* and *grand mal*, recurring separately or together, may often herald a harmless insanity with the highest degree of melancholia with stupor, without the least violent reaction—which, as set forth by Falret, should exclusively occur upon the physical *grand mal*. In other common instances, the epileptic, without any dejection or stupor, but excessively disposed to react violently on the slightest moral or physical incitation, talks and acts coherently, in an apparently rational manner, but actually without any appreciation whatever of his outward relations—a strange state that may occur along with diurnal or nocturnal fits, or irrespective of any manifest physical paroxysm, as the only exponent of the epileptic malady. For all these reasons, instead of attempting to establish an immediate relation of cause to effect—which cannot be proved—between the psychical and physical paroxysms, it is safer to regard epileptic insanity, or, using a more adequate term, *cerebral epilepsy*—as one of the manifestations *per se* of the spasmodic neurosis, recognising its essential source, not in this or that kind of fits, nor in their frequency, but in the very pathogenetic elements of the disease. Unconsciousness, with an excessive reflex susceptibility, displays itself as the chief characteristic of cerebral epilepsy, capable of occurring either alone, or coupled with any other form of the epileptic malady, preceded sometimes by an *aura*, identical to that which may foretell other attacks.

Description.—Assuming the practical view above maintained, it is readily observed that epileptic insanity—like every other variety of insanity—manifests itself under an *intermittent*, a *remittent*, and a *continuous* form.

The *intermittent* form is characterised by periodical attacks, breaking out at irregular intervals, either before or after the fits, which, moreover, often explode as though they were an intercurrent accident of the maniacal seizure. When this latter directly follows the *grand mal*, the patient instantly passes from the clonic stage of the fit into the maniacal, without any intermediate period of sleep or coma. The intermittent attacks of cerebral epilepsy rarely last less than two or three hours; they may be developed one or more days after instead of closely accompanying the fits, and ordinarily have then a longer duration; or, again, the intellectual disorder may reach its most dreadful stage without any spasmodic fit being seen or suspected. Morel proclaims that in these cases the occurrence of convulsions never fails to disclose the true nature of the insanity, as such patients ultimately arrive at the convulsive fit and die. This, however, is too absolute a statement, for undoubted cases of cerebral epilepsy are frequently met with, without the supervention of any spasms in the final state of cerebral congestion, the patient sinking into a profound coma, but sometimes executing automatically in this insensible state the same movement of the head, or some other habitual gesture. It is in intermittent cerebral epilepsy that unconsciousness appears most strikingly, although no reference has been hitherto made to its clinical or far-reaching medico-legal significance, nor to the explanation it furnishes to the strange oblivion or amnesia, so peculiar to epilepties after the commission of their criminal acts. Religious monomania and erotomania are common in the earliest stages of intermittent cerebral epilepsy. However, the peculiar disposition to wander about in an aimless manner, the volubility and instantaneous changes characteristic of the deportment of individuals labouring under this stage, may be transformed into an opposite manner of acting, the epileptic then remaining for hours or days entirely motionless and silent, with a sullen expression of countenance, in a physical and mental condition which almost verges on catalepsy, and involuntarily passing his urine and excrements, like those suffering from stupidity or *melancholia attonita*.

No complete recovery of intellectual soundness takes place between the paroxysms or maniacal exacerbations of *remittent* epileptic insanity. In the *continuous* form the mental trouble persists throughout, not essentially modified by the recurrence of the fits. In either instance dementia, imbecility, or a range of symptoms very similar to those of general paresis, is more noticeable than the unconsciousness with high irritability and sudden violent acts observed in the intermittent cases. The remittent and continuous forms offer no embarrassment as to their diagnosis, and afford, upon close examination, the most typical examples of *folie circulaire*.

The intermittent cerebral epilepsy, which occurs in no proximate connection with any fit of *grand mal* or *petit mal*, corresponds to the *larvated epilepsy* of Morel, *intellectual epilepsy* of Maudsley, *psychical epilepsy* of Kraft-Ebing; and most of the cases of the so-called *instinctive mania* (*manie sans délire*), and of *mania transitoria* also belong to this category. The main points to observe in this perplexing aspect of the spasmodic neurosis are the following:—Cerebral epilepsy implies an advanced stage of the epileptic malady, but may and does nevertheless appear at any time throughout its progress, even when it has been developed in a sort of hidden or larvated manner. The discrimination between larvated epilepsy and other forms of intermittent mania is rendered easy by a reliable account of the antecedents of the patient. The demonstration of parents stained with any constitutional nervous disease, or addicted to intemperance, an extreme susceptibility to anger, with strange peculiarities of character, moral depravity, and a more or less dwarfed development of the intellectual faculties, in addition to

the onset of fits during infancy, or adolescence, and subsequent vertigo or fainting fits or instantaneous absence and giddiness, are elements of diagnosis which evince the true epileptic nature of any transitory, instinctive, or mental disorder that has recurred without variation, or with such a complete resemblance to the preceding paroxysms as we notice but exceptionally in any other kind of mania. The attacks of cerebral epilepsy recur with the periodicity and similar premonitory symptoms peculiar to other epileptic paroxysms. When displayed from the beginning, as after traumatic injury to the head, syphilis, &c., they ordinarily recur at shorter intervals than otherwise. The manifestations of cerebral epilepsy are never solitary, they involve a repetition of fits of mental or physical character. Consequently, such insanity, as already advanced, discloses an active but not ultimate progress of the epileptic malady, and hence the possibility of its cure or relief. Epileptic insanity is rarely manifest before puberty, for idiotcy accompanies congenital epilepsy in *idiotic epileptics*, and imbecility the epilepsy which develops itself during childhood in *epileptic imbeciles*. There is a clear relation between the intensity and length of the epileptic insanity and the impediment to the cerebral circulation, which in its extreme degrees may terminate in meningitis. Giddiness with perspiration of the head, sometimes very profuse, and epistaxis, are symptoms existing during or immediately after the paroxysms. The cerebral congestion is further betrayed by the bloated and livid appearance of the face; the injection of the conjunctivæ, with a thick white discharge collected in the angles of the eyelids; and the heavy look of the patient. The pupils during the exacerbations of the paroxysm—when the patient becomes boisterous and violent, exhibit a dilatation and contraction, like that which may last for several seconds or even a minute after the fits of *petit mal* or *grand mal*. Slowness of the respiratory activity, with marked loss of its normal relation to the pulse, is regularly detected in every case where the *epileptic habit* has become well established, as also an increased temperature of the skin before the explosion of the attack, ordinarily attended with incontinence of urine when it takes place during sleep in nocturnal epilepsy. There is always at the close of the fit of epileptic insanity a period of sleep, which effects the transition to a sound condition of mind. This sleep may be prolonged several hours, accompanied by a heavy breathing or snoring, which makes it easily mistaken for the sleep of drunkenness, a mistake strongly countenanced by the quick recovery of the patient. Another conspicuous sign of epileptic insanity is the *epileptic echo*, or repetition by the patient of the same word or phrase addressed to him, or present in his mind. Romberg has described the *echo sign* as indicative of softening in cerebral diseases, but in epilepsy it chiefly evinces a perverted will. The phenomenon renders itself very evident in the writings of the epileptic insane, even during the very occurrence of the fit, thus affording confirmation of the automatic repetition of motory and intellectual acts so peculiar to epilepsy.

Morbid sensorial phenomena of various kinds existed in 86 per cent. of 267 cases of epileptic insanity. Hallucinations of hearing were recorded in 62 per cent. of the said number; of sight in 53 per cent.; of hearing and sight in 42 per cent.; of smell in 6 per cent.; and finally about 30 per cent. of the cases showed some disturbance of general sensibility, such as anæsthesia, hyperæsthesia, &c. If we take into account the almost constant occurrence of some of these morbid sensations, and the hyperæsthetic condition attending epileptic insanity, it will not be difficult to realise the manner in which its victims are fascinated by the feelings they experience, which ordinarily assume the most frightful and deceitful character. Whenever we have data for comparison, we shall see that the hallucinations of hearing are the most frequent, as shown by the foregoing statistics. Morel has, with great propriety, insisted on the unmistakable character of these hallucinations of hearing, and the piercing sudden noises, usually heard by epileptics, differing entirely from the noises complained of by those labouring under the delirium of persecutions, which always lead an attentive observer to a definite diagnosis of cerebral epilepsy.

The intellectual aura, which like precursory clouds of a threatening storm may anticipate the outbreak of a fit of cerebral epilepsy, is an accessory symptom common to all the attacks, already noticed in the general description. In regard to the moral and intellectual changes which characterise epilepsy, and may be superinduced from its very outset, effacing—as Maudsley says—the moral sense as it effaces the memory, there is one brief remark to be made. Such moral depravity is more apt to occur from the very inception of the attacks, when epilepsy is induced by a traumatic injury to the head; its appreciation is beset with difficulties, and although these morbid dispositions do not constitute a state of insanity, they must place the epileptic—as justly declared by Baillarger—beyond the common rule, and extenuate at least his legal responsibility.

Legal Relations.—Bearing in mind the reflex nature of the physical and mental phenomena inherent in epilepsy, and our inability to avoid the effects of reflex actions, it follows as a matter of course that epileptics should be regarded irresponsible for any criminal act they might commit under the influence of a paroxysm. Those familiar with epileptics know that the majority have no knowledge, or at least a very imperfect idea, of their misdeeds, such state of unconsciousness being the chief characteristic of epileptic insanity generally. This unconscious cerebration exhibits itself in a high degree in epilepsy, but is not peculiar to it, for we observe it more or less in all forms of insanity, and notably in somnambulism. Finally, a clear demonstration of the above-described phenomena is indispensable before we can fully appreciate or decide upon the nature of any act perpetrated during an alleged condition of epilepsy.

The reasons here briefly presented for the irresponsibility of confirmed epileptics prove no less forcibly that society, in its turn, must be protected from their misdeeds, since they are unquestionably the most dangerous class of individuals. Therefore criminal epileptics should

never be allowed to go at large until sufficient time has elapsed to demonstrate the arrest of their malady, upon continued observation by a competent physician.

TREATMENT.—The treatment of epileptic insanity does not differ from that of epilepsy generally (*see* EPILEPSY). Let it be simply noticed that ergotine in doses of three to six grains, and succus conii in doses of three drachms to one ounce, in often repeated doses, with counter-irritation to the lower part of the neck (seton or cautery), and cold shower-baths or packing, are among the most reliable means to be resorted to, to abate or prevent the great excitement of the insane epileptic. M. G. ECHEVERRIA.

EPIPHORA (ἐπὶ, upon, and φέρω, I carry). A flow of tears, so persistent that they run down the cheek, due either to obstruction of the lachrymal duct or to excessive secretion. *See* LACHRYMAL APPARATUS, Diseases of.

EPIPHYTA (ἐπὶ, upon, and φυτὸν, a plant). These are the plant-like organisms found on the skin, and its appendages or on mucous surfaces, the so-called *vegetable-parasites*, originating certain diseases, such as the various forms of tinea and thrush. The more important of them are the Achorion, Trichophyton, and Microsporon. The achorion Schoenleinii is the vegetable fungus which constitutes the mass of the crusts of favus, and belongs to the group of Oidiæ. The trichophyton is the dermatophyte of tinea and sycosis, and is found in the substance of the hair as well as in the epidermis. The microsporon, termed Epidermophyton by Bazin, is the parasitic fungus of phytosis versicolor. Both the latter are members of the group of Torulaceæ. *See* EPIPHYTIC SKIN-DISEASES, and APHTHÆ. ERASMUS WILSON.

EPIPHYTIC SKIN-DISEASES,—SYNON.: Vegetable parasitic skin-diseases; *Tineæ*; Dermatophytic diseases.

DEFINITION.—Epiphytic diseases are diseases due to the attack upon the integuments of parasitic fungi.

DESCRIPTION.—Speaking generally it may be said that an epiphytic disease consists of three component elements—(*a*) a soil favourable to the growth of the attacking epiphyte; (*b*) the growing epiphyte itself; and (*c*) the effects produced upon the skin-tissues by the development and increase amongst them of the epiphyte.

Epiphytic Soil.—As regards the soil it is difficult to exactly describe it, but it is indisputable that the young, those whose assimilation is at fault, the lymphatic, and fair children, furnish a soil peculiarly favourable to the growth of vegetable parasites.

The Epiphyte.—The epiphyte itself consists of reproductive cellular bodies called *conidia* or sometimes spores, formed of an outer envelope composed of cellulose, and an inner membrane or utricle, enclosing granules floating in a liquid, and mycelial filaments. The spores are round (as in tinea tonsurans) or oval (as in favus), having an average diameter of ·006 mm., and furnished in most cases with a nucleus. These conidia are double-contoured, solitary, or arranged in rows, or massed in groups (tinea versicolor). The mycelial threads vary somewhat in appearance; they may be fine transparent filaments, or large distinct double-walled tubes. They are jointed by real dissepiments, and more or less constricted, and contain granules and cells, whilst the terminal filaments bear various forms of fructification. In many cases there is a stroma, made up of a number of very small granules, resulting from the subdivision of the granules and cells in the interior of the filaments, and even of the conidia. Some question the vegetable nature of these fungus-elements, and aver that they represent a granular degeneration of normal skin-structure; but no transitional stages have been discovered betwixt the two structures. Further, these fungi can be made to develop the characteristic fructification of the common moulds of undoubted vegetable nature, and similar fungi occur in situations—as the hard structure of corals, &c.—in which they could not have been derived from any kind of epithelial or other animal tissue. Conidia may readily be mistaken for fatty granules and *vice versâ*. But the former refract light strongly, are nucleated, and unaffected by ether in the least degree.

Effects.—Concerning the effects induced by their growth in the skin, it may be said that fungi act like ordinary irritants, inducing inflammation of the skin; and as the fungi grow equally in all directions from a given centre, the eruption is usually circular. Its signs are most marked at the circumference, where the fungus is in its most active state; but, in addition, the fungus invades the epithelial tissues; grows downwards into the follicles, causing irritation and effusion therein; then gradually attacks the hairs or hair-shafts, absorbing their moisture, separating the component fibres, and causing the hairs to become thickened, more or less opaque, twisted, uneven in size along the shaft, and brittle, so that they easily break. Nothing but the growth of fungi in them can produce the disease of the hair observed in the epiphytic diseases.

VARIETIES.—There are seven clinical varieties of undoubted epiphytic diseases, and an additional one, about which great difference of opinion has been expressed. The seven are as follows:—

1. *Tinea favosa* or *favus*, or honeycomb ringworm, caused by the *achorion Schönleinii*.

2. *Tinea tonsurans* (ordinary ringworm of the scalp), the fungus occurring in connection with it being termed *trichophyton tonsurans*.

3. *Tinea kerion*, a modification of the last-named, having the same parasite, and being characterised by inflammatory prominence of the follicles, and exudation therefrom of viscid fluid.

4. *Tinea circinata* (ordinary ringworm of the body), including the ringworms of Oriental places,—Burmese, Chinese, Indian ringworm, &c., having the same parasite as tinea tonsurans, and only differing from it essentially in the fact of its occurrence on the non-hairy parts.

5. *Tinea sycosis*, or ringworm of the beard; the parasite being *microsporon mentagraphytes*.

6. *Tinea versicolor* or *phytosis versicolor*, the *chloasma* of English writers; the parasite of which is *microsporon furfur*.

7. *Onychia parasitica* or *onychomycosis*, parasitic disease of the nails, caused by the growth

in the nail of the fungus of tinea tonsurans or tinea favosa; in other words, the trichophyton or the achorion.

At one time it was thought that the disease known as *tinea decalvans* was parasitic and caused by the growth of the *microsporon Audouinii*, but this is at present a disputed point. *See* ALOPECIA.

These several varieties of tinea will be described in detail under that heading.

TREATMENT.—The principles of treatment in parasitic disease consist in improving the tone of the nutrition, and in bringing parasiticides into contact with the fungus-elements, so as to ensure their destruction; the latter, however, is a matter of much difficulty when the fungi are imbedded deep in the hair-follicle, or in the lower parts of the shafts of the hairs of the scalp. *See* TINEA. TILBURY FOX.

EPIPLOITIS (ἐπίπλοον, the omentum).—Inflammation of the epiploon or great omentum. *See* PERITONÆUM, Diseases of.

EPISPADIAS (ἐπί, upon, and σπάω, I draw).—A malformation of the penis, in which the urethra opens on its upper surface. *See* PENIS, Diseases of.

EPISPASTICS (ἐπί, upon, and σπάω, I draw). Substances which, when applied to the skin, are capable of producing a blister. *See* COUNTER-IRRITANTS.

EPISTAXIS (ἐπί, upon, and στάζω, I drop). SYNON.: Fr. *Épistaxis*; Ger. *Nasenbluten*.

DEFINITION.—Epistaxis signifies a bleeding from the nose.

ÆTIOLOGY.— Epistaxis is either *traumatic* or *idiopathic*.

The *traumatic* form may be occasioned by violent sneezing, by snuffing up irritating substances, or by direct violence; but in these cases there frequently appear to be general or local *predisposing* causes, to account for the readiness with which it occurs, such as a hæmorrhagic diathesis, an inflammatory or congestive hyperæmia, or some ulceration of the mucous membrane.

The *idiopathic* form of epistaxis frequently occurs in children, particularly boys, just before or about the age of puberty, and in girls as a form of vicarious menstruation. Epistaxis may be one of the forms of bleeding in persons of hæmorrhagic diathesis, in which case it is a source of anxiety and difficulty. Occurring in advanced life, it may be indicative of over-distension or obstruction of the cerebral venous system from chronic Bright's or cardiac disease; and the blood which flows is then often venous in appearance. Occasionally it occurs as a spontaneous relief to determination of blood to the head, in which form the blood generally proceeds from one nostril only. In other instances epistaxis is connected with serious disorder of the blood, as in the specific fevers. Thus it is often associated from the outset with remittent, enteric, typhus, or scarlet fever, and is indeed regarded in some degree as pathognomonic of enteric fever. It may also attend scurvy, purpura hæmorrhagica, splenic disease, pyæmia, and erysipelas, being a sequence of the septic condition.

In its passive form, epistaxis is often associated with organic disease of the heart, pleurisy, emphysema; or with ascites or ovarian dropsy, on account of pressure on the diaphragm inducing a stasis of the venous circulation. It may occur spontaneously from exposure either to great cold or great heat, or a sudden change from cold to heat, or from the diminution of atmospheric pressure, as in going up high mountains.

SYMPTOMS.—Hæmorrhage from the nose is too familiar to demand description in this place. The flow of blood may be either continuous or drop by drop. As a rule, the escape of blood is from one nostril, bleeding from both being rare. It may last a very short time, or for some hours, and in severe instances for days, causing syncope, or even being attended with fatal results. It is at times met with as occurring periodically.

DIAGNOSIS.—Epistaxis must not be confounded with hæmoptysis, as may happen if the epistaxis takes place posteriorly, and the blood passes into the mouth.

TREATMENT.—When epistaxis is obviously a salutary process, as it undoubtedly is in a good many instances, it subsides spontaneously; where it occurs frequently and severely, recourse must be had to mechanical, cutaneous, and internal remedies. The local application of cold in the form of cold water or iced compresses to the nose, neck, or forehead is most useful, acting as these agents do either directly or by inducing a reflex effect on the vaso-motor nerves. Simple pressure upon the nostril, or upon the septum nasi, by compressing the bleeding nostril with the finger of the opposite hand, while the arm of the affected side is raised above the head, is the most readily practicable and effectual of all measures. The application of mustard over the stomach or upon the ankles is sometimes successful. When simple means fail, astringents, either in the form of solution or powders, may be injected into the cavities, or applied on plugs of lint or cotton-wool, such as alum, acetate of lead, the salts of iron, or gallic or tannic acid.

Internally, the frequent administration in small doses of tinctura ferri perchloridi, turpentine, bromide of potassium, or belladonna and quinine may be necessary in cases of periodic attacks.

In very severe cases the operation of plugging the nares, and thereby favouring the formation of a clot, must be resorted to, and the most ready and easiest method is by the employment of Bellocq's sound, or more properly canula. If, however, this instrument be not at hand, a catheter or an eyed probe should be threaded with a stout silk or hemp ligature, and pushed along the floor of the nose, until it protrudes beyond the velum palati; one end of the thread should now be pulled out of the mouth by the fingers or forceps, and a roll of lint or a piece of sponge tied to it, and then pushed up behind the velum. The catheter and the attached thread being now withdrawn through the nostril, the plug is pulled forcibly against the posterior nares, and by the pressure exerted the hæmorrhage can generally be arrested. EDWARD BELLAMY.

EPISTHOTONOS (ἐπισθεν, forwards, and τείνω, I extend).—A synonym for emprosthotonos. *See* EMPROSTHOTONOS.

EPITHELIOMA (ἐπί, upon, θάλλω, I grow —epithelium; and ὁμός, like).—A variety of cancer, consisting essentially of epithelial elements. *See* CANCER.

EPITHELIUM, Diseases of.—The different kinds of epithelium must be separately considered, as they differ in their pathological relations, namely, *squamous* and *cylindrical* epithelium of mucous surfaces; *serous* epithelium, or *endothelium*; and finally *spheroidal* or *glandular* epithelium. The last kind will be better treated of under the heads of the several glands.

A. DISEASES OF SQUAMOUS AND CYLINDRICAL EPITHELIUM.—1. **Catarrhal Inflammation.**—Both varieties of epithelium occurring on mucous surfaces are subject to inflammation, which usually takes what is called the catarrhal form.

Catarrhal inflammation is characterised by hyperæmia, swelling of the tissue, rapid production and casting-off of cells, and increased production of the normal mucous secretion of the parts, without the production of any coagulable exudation, or any layer of new material. The cells thrown off are partly epithelial, partly leucocytes or pus-cells. The secretion contains mucin. The proportion of the various factors of catarrhal inflammation varies greatly, sometimes hyperæmia with swelling, sometimes cell-production, sometimes fluid secretion predominating; and these differences sometimes mark different degrees or stages of the inflammatory process. When the number of leucocytes thrown off is very large, the catarrh becomes purulent, which differs only from the other in degree. Catarrhal inflammation is the ordinary result of irritation applied to a mucous surface; but it persists after the irritation has ceased, and has a marked tendency to become chronic. While the chief share in producing and maintaining the phenomena of catarrh must be referred to the condition of the blood-vessels of the mucous membrane, the part played by the epithelial cells in these processes is a point of great interest and importance, though as yet imperfectly determined. These cells, whether squamous or cylindrical, enlarge and alter in shape, while there must be (since so many are shed) a rapid new formation of them; but the seat of this new formation, whether in the normal or the pathological condition, is still obscure. Further, it is not unusual to find swollen epithelial cells which show division of the nuclei or partial division of the cell itself, and others which show within their substance several smaller, roundish bodies, with the general character of young cells. These appearances have been regarded as indicating (1) multiplication of cells by fission, (2) endogenous cell-formation within the mother-cells, and (3) the origin of the numerous pus-corpuscles seen on the inflamed surface. There is, however, no reason for thinking that new epithelial cells are thus formed. By others again the presence of pus-corpuscles or young cells within the epithelial cells is regarded as an unimportant and accidental complication, the young cells which possess the power of migration being absorbed into the protoplasm of the epithelial cells, so as to appear as if originally formed there. The production of vacuoles or spaces in the altered epithelial elements is also explained in two ways, either as a part of the process of cell-proliferation, or as indicating partial absorption of the substance of the cell. It must therefore be regarded as still uncertain, whether epithelial cells do, by a process of proliferation, give rise to any new elements.

2. **Croupous Inflammation.**—Croupous inflammation is distinguished by showing, in addition to hyperæmia and swelling, the production of a layer of new material, or false membrane, easily detached from the surface. This form is usually, if not exclusively, seen on surfaces covered with cylindrical epithelium, as in the air-passages. The false membrane, composed of fibrin cementing together layers of detached epithelium and leucocytes, does not owe its origin to any alteration of the epithelium itself.

Croupous inflammation of epithelial surfaces has been regarded as always indicating some specific form of inflammation. It now appears, however, that it may be produced by simple irritation, such as that which produces the catarrhal form, provided the irritation be sufficiently intense.

3. **Diptheritic Inflammation.**—This is a name used with much variation of meaning, but generally to signify a process in which there is production of a false membrane closely adherent to the epithelial surface, and which is accompanied by some degree of necrosis or gangrene. In the production of the diphtheritic false membrane an important part has been assigned to the epithelium, it being held that the new material which appears like exuded fibrin is really produced by a metamorphosis (the so-called *fibrinous transformation*) of the pavement epithelium. It is pretty clear that when this condition occurs on surfaces covered with this variety of epithelium some such change in the epithelium does take place, but not that the membrane is made up wholly or even in any large degree of such altered cells. Moreover, even this cannot be clearly traced on surfaces covered with cylindrical epithelium. The membranes consist in large measure of cast-off epithelium, and also (as the writer holds) partly of fibrin, though the presence of the latter constituent is denied by some authors. It should be noted that the terms croupous and diphtheritic inflammation, as here used, are not synonymous with the diseases named croup and diphtheria.

4. **Fatty Degeneration.**—It is very common to find the protoplasm of both squamous and cylindrical epithelial cells dotted with oil-globules, so much so that this must be considered normal, to a certain extent, in some glandular epithelium (as kidney), and does not appear to interfere with the function of the cells. When the fatty change, however, is extensive, and more especially when the whole body of the cell is opaque, the condition must be regarded as one of fatty degeneration (*see* FATTY DEGENERATION). This is seen in the stomach in cases of alcoholism, in poisoning with metals or phosphorus, and in cases which are probably nothing more than chronic catarrh. It is also seen in the alveolar epithelium in pulmonary emphysema. Fatty degeneration appears in epithelium to be a process leading to atrophy.

5. **Mucous or Colloid Degeneration.**—Epithelial cells, especially in parts which are naturally adapted to the production of mucus, particularly cylindrical epithelium, are liable to undergo a form of degeneration in which a portion of their protoplasm becomes converted into mucous substance, and thus liquefied. Cells having this character are often seen in catarrhal conditions of the mucous membrane of the air-passages, but the change does not appear to occur as a substantive disease. It has not been traced in squamous epithelium.

6. **Albuminoid (Waxy or Amyloid) Degeneration.**—This form comparatively rarely affects epithelial cells, but still in cases of albuminoid disease we may sometimes find that the mucous surface of the intestines is stained with iodine in the characteristic manner. In one or two cases the writer has observed a similar change in the surface of the pelvis of the kidney, and even the bladder, where there has been albuminoid disease of the kidney.

B. Diseases of Endothelium.—The single layer of flat epithelium found on serous surfaces, which differs so much from the other forms as to be now generally known by another name, *endothelium*, differs also in its pathological relations.

1. **Catarrhal Inflammation** is unknown on serous membranes, their characteristic form of inflammation being exudative and fibrinous, corresponding thus to the

2. **Croupous Inflammation** of mucous surfaces. In this inflammation the endothelium does not necessarily take any part, though when the inflammation is once established the endothelium is, in part, simply shed, in part shows changes of a proliferative kind; cell-division, multiplication, and endogenous cell-formation being observed here with less ambiguity (as it appears to the writer) than in the epithelium of mucous surfaces. Similar changes appear to occur in chronic inflammation of serous surfaces, and to play an important part in the production of fibrous adhesions between opposing surfaces.

3. **Fatty Degeneration.**—Endothelial cells are also subject to fatty degeneration, which may be very clearly seen in surfaces macerated by a collection of fluid, as in serous effusions of the peritoneum or pleura.

The other pathological changes of endothelium have not been studied.

The epithelium (or endothelium) lining the inner surfaces of the walls of arteries and veins, closely resembles the endothelium of serous surfaces. It is very subject to fatty degeneration, as may be seen on examining atheromatous arteries. Proliferative changes have also been traced by some observers in the process of occlusion of ligatured arteries or veins obstructed by thrombosis; but they do not appear to play any important part in idiopathic disease.

C. Diseases of Glandular Epithelium.—The diseases of glandular epithelium are best spoken of under the head of diseases of the several glands. *See* Breast, Diseases of; &c.

J. F. Payne.

EPITHEM (ἐπί, upon, and τίθημι, I place). A general term for a class of external applications which are soft and moist, such as poultices and fomentations. *See* Fomentations, and Poultices.

EPIZOA (ἐπί, upon, and ζῷον, an animal).—A term formerly much used by zoologists to characterise a peculiar and distinct group of parasitic creatures which attach themselves to fishes, but now more generally employed to embrace all kinds of parasites having the habit of residing in or upon the surface of the body of man and animals. In the writer's judgment the more comprehensive term *Ectozoa* is preferable, and the distinctions which have been created as to the relative value of these two terms ought to be abolished. In any case it should be understood that the equivalent terms epizoa and ectozoa have no zoological significance, being simply employed for convenience' sake when we are speaking of external parasites, of whatever character; in contradistinction to the term entozoa. The epizoa comprise such parasites as lice and mites (*Dermatozoa*), and the term might also be made to include fleas, bugs, and other creatures whose residence on the surface is only occasional, and of very short duration. *See* Parasites, and Entozoa; also Acarus, Demodex, Chigoe, Pediculus, and Œstrus. T. S. Cobbold.

EPULIS (ἐπί, upon, and οὖλον, the gum). *See* Mouth, Diseases of.

EQUINIA (*equus*, a horse).—A synonym for glanders. *See* Glanders.

EQUINIA MITIS. *See* Glanders.

ERETHISM (ἐρεθίζω, I irritate).—A condition of excitement or irritation, affecting either the whole system or a particular organ or tissue. The word has been especially applied to the condition of the body in the early stage of acute diseases, and also to that induced by the too free use of mercury (*mercurial erethism*). *See* Mercury, Poisoning by.

ERGOTISM.—Synon.: *Morbus cerealis*; Fr. *Ergotisme*; Ger. *Ergotismus, Kriebelkrankheit.*

Definition.—A disease due to the action of ergot upon the organism.

Ætiology.—This disease derives its name from the fact that it is the result of the ingestion of ergot—the stroma of a fungus called *Claviceps purpurea*, which grows parasitically in the ear of the Rye. In some seasons this form of blight affects the grain so extensively that ten per cent. of the meal may consist of ergot. The phenomena to be described as symptoms of ergotism have been regularly and exclusively traced to the use of articles of food made from rye-meal thus contaminated. The appearance and severity of the disease vary with the amount of ergot consumed. Children at the breast are never attacked. Ergotism has frequently broken out in well-marked epidemics, after unfavourable harvests. In ruder times it constituted a severe form of scourge; but now it usually occurs sporadically, or is limited to families or small communities.

Anatomical Characters.—Nothing definite is known respecting the morbid anatomy of ergotism.

Symptoms.—Within a few days of the first ingestion of meal poisoned with ergot, the ordinary phenomena of irritant poisoning are developed, namely, vomiting, diarrhœa, severe abdominal pains and cramps, and general depression—giddiness and headache being specially marked.

Along with the preceding, certain special symptoms gradually make their appearance. The first and most characteristic of these is formication, attended with severe itching of the skin of the extremities. The other special senses, such as vision and hearing, may also become disordered. Occasional spasms occur in the muscles. Ravenous hunger is said to be a striking symptom in some instances. The pulse is infrequent and small. Respiration is not markedly disturbed.

The remaining phenomena peculiar to ergotism are usually described as belonging to two forms, the *gangrenous* and the *spasmodic*, according as the circulation or the nervous system is chiefly affected.

a. Gangrenous Ergotism.—Gangrene, due to ergot, is peculiar only in respect of its cause. The toes, fingers, feet, ears, and nose are the parts most commonly attacked. The incipient discolouration, pain, and swelling are observed within a period of two days to three weeks from the commencement of the other toxic symptoms. The necrotic process passes through the ordinary stages of development; may be either 'wet' or 'dry;' and advances to complete separation of the part, if this have not been previously removed by operation.

b. Spasmodic Ergotism.—The leading symptom of this form of the disease is the occurrence of severe intermittent cramps or painful spasms, specially affecting the lower extremities. These develop into tonic contraction of the muscles, with fixation of the limbs; and end perhaps in general convulsions, prostration, unconsciousness, and death. Abortion does not appear to be of frequent occurrence.

Course, Duration, and Terminations.—Many cases of ergotism are acute rather than chronic; but when gangrene appears, the course may be very protracted and variable. Spasmodic ergotism may last from two weeks to as many months. The mortality is said to have fallen from sixty to ten per cent. In a few cases, resolution occurs in affected extremities.

Pathology.—Beyond its effect as an irritant poison, the specific influence of ergot is exerted upon the organs of circulation, upon the central nervous system, and upon the uterus.

The Circulation.—Ergot produces a remarkable slowing of the cardiac rhythm; the arteries become contracted, with diminution or even disappearance of their channel, or formation of thrombi; the blood-pressure falls; and the veins become dilated and distended. The most recent and consistent theory respecting these phenomena is, not that the muscular coats of the arteries actively contract, but that the venous walls are primarily relaxed. The veins are thus overfilled, and the arteries drained of blood; the blood-pressure is lowered; and the heart being insufficiently fed, contracts feebly and slowly.

The Nervous System.—Certain of the spinal centres, both motor and sensory, are first stimulated and afterwards paralysed by ergot—directly, according to some authorities, indirectly according to others.

The Uterus.—The unquestionable action of ergot upon the uterus is explained by some authorities as due to stimulation of the centre for the uterus in the cord. Others consider that ergot acts upon the muscular fibres of the organ, either directly or indirectly through the blood-supply.

Whatever may be the value of the several 'explanations' of the action of ergot, the facts connected with it suffice to account for the specific phenomena of ergotism. The small, feeble, and infrequent pulse are due to interference with the circulation; while the painful spasms, as well as the formication and other sensory disturbances, are the direct result of the action of the poison upon the cord. The gangrene may also be partly due to the latter cause.

Diagnosis.—The occurrence of gangrene in a number of young and previously healthy persons should remove all difficulty from the diagnosis of ergotism. The spasmodic form of the disease may be distinguished from epidemic cerebro-spinal fever by the absence of pyrexia.

Prognosis.—The prognosis depends chiefly upon the early recognition and removal of the cause. The probability of the escape of affected extremities may be estimated by the degree to which the gangrenous process had advanced.

Treatment.—The treatment of ergotism consists in removing the cause of the disease; in hastening the elimination of the poison by the cautious administration of emetics and purgatives; in allaying the symptoms of gastro-enteritis; and in supporting the strength of the patient by internal and external stimulants, such as alcohol, warmth, and friction. Gangrene must be averted by careful local stimulation, by means, for example, of warm fomentations; or treated, if it should arise. *See* Gangrene.

J. Mitchell Bruce.

EROSION (*erodo*, I gnaw).—A superficial destruction of tissue, caused especially by friction, pressure, corrosion, or certain forms of ulceration.

EROTOMANIA (ἔρως, love, and μανία, madness).—Synon.: Love-melancholy, Satyriasis (in men); Nymphomania (in women); Fr. *Monomanie érotique*; Ger. *Liebeswuth.*—Insanity characterised by excessive sexual excitement; sometimes symptomatic of cerebral lesion, sometimes of disorder in the reproductive organs. *See* Insanity

ERRATIC (*erro*, I wander).—Wandering, shifting, or irregular. Applied to pains, eruptions on the skin, and other morbid phenomena when they shift or move from place to place.

ERUCTATION (*eructo*, I belch).—Definition.—The sudden escape or expulsion of gas from the stomach upwards, with or without an admixture of portions of liquid or solid food, or of gastric juice, or other liquids.

Description.—The act of eructation may be voluntary or involuntary. In the former case a small portion of air is first swallowed, and by

he over-distension thus produced the escape of portion of the gaseous contents of the stomach s favoured. When involuntary, we must sup- ose that the cardiac orifice, which is closed in he normal state of digestion, is relaxed, and hus permits the rejection of portions of un- igested matter. From the violence with which ructations often take place, we may also ssume that the muscular coat of the stomach ontracts spasmodically at the same moment hat the relaxation of the cardiac opening oc- urs. The nature of the material rejected varies reatly. Sometimes it is tasteless, in others acid, nd in rarer instances alkaline.

Ætiology.—Eructations occur in all gastric liseases attended with an undue formation of gas. They are constantly complained of in atonic lyspepsia, more especially in that form which occurs in elderly people, and are probably the result of an imperfect contraction of the sto- mach, preventing the due expulsion of the digested food into the intestine. They form a prominent and distressing symptom in dilatation of the stomach. In such cases the patient often complains of a sense of fermentation in his abdomen, and immense quantities of gas are expelled, generally mixed with an acid or acrid fluid.

Treatment.—The indications in the treat- ment of eructations are to prevent the decom- position of food, and the formation of gases and other products; to restore tone to the stomach, and remove any morbid condition of this organ; and to give remedies with the view of absorbing gases, or assisting the act of eructation. *See* Stomach, Diseases of. Samuel Fenwick.

ERUPTION (*eruptio*, a bursting forth).—This term is commonly applied to a pathological manifestation in the skin; more or less general; sometimes marked by colour, sometimes by pro- minence, but more frequently by both. When sudden and hyperæmic, a term derived from the efflorescence of a plant, namely, *exanthema*, is employed, as in the instance of the exanthematous eruptions—scarlatina, rubeola, roseola, and va- riola. The term is equally applicable to less acute forms of dermatosis, such as urticaria, eczema, impetigo, ecthyma, acne, and furunculus; and is also used for still more chronic forms of disease, for example, lepra vulgaris; and for outgrowths of the skin, due to aberration of nutrition, as in the instance of warts and molluscous tumours.

Erasmus Wilson.

ERYSIPELAS (ἐρύω, I draw, and πέλας, near).—Synon.: Lat. *Erysipelas*; Fr. *Érysipèle*; Ger. *Erysipelas*. Popular names:—St. Anthony's Fire (English); the Rose (Scotch); *der Rothlauf*, and *die Rose* (Ger.)

Definition.—Inflammation of the integument tending to spread indefinitely (*Royal College of Physicians' Nomenclature of Diseases*). The vague- ness of this definition indicates the looseness with which the term is employed. The features common to all inflammations usually spoken of as erysipelatous are fever, usually preceding the local phenomena; and an inflammation tending to spread indefinitely by means of the lymph- spaces and lymphatic vessels of the affected part.

Summary of Varieties.—Erysipelas is usually divided into (*a*) Simple Cutaneous, (*b*) Phleg monous or Cellulo-cutaneous, and (*c*) Cellular, or Diffuse Cellulitis (Nunneley). In addition to these three chief varieties, erysipelatous inflam- mation of the lymphatic vessels and veins, and of serous and mucous membranes, is also de- scribed.

Pathology.—All the inflammatory affections thus loosely classed together, as erysipelas in its various forms, have one feature in common. They all belong to the class of infective inflammations —that is to say, the inflammatory products pos- sess the property of setting up an inflammation similar in character to that at the original focus in any part with which they may come in contact. In erysipelas these infective products diffuse themselves by the lymphatic vessels and lymph- spaces, and thus set up a spreading lymphatic inflammation. As the poison diffuses itself, it seems in most cases to lose its intensity, and thus the spreading is finally arrested. Of the exact nature of the poison we know nothing definite. As in other infective inflammation the exudation-matter contains minute organisms (micrococci); but the part these play in produc- ing the disease, and their mode of origin, are matters of dispute. The poison, whatever it may be, is communicable from one individual to another. It is probable, however, that simple cutaneous erysipelas differs entirely in nature from cellulo-cutaneous and cellular erysipelas. The two latter are in most cases purely local in origin, and the poison which causes them pro- bably varies, both physically and chemically, in different cases. In some cases it may be merely decomposing animal-matter, in others it may be something as truly specific as the infective pro- ducts of malignant pustule or the poison of a venomous reptile. The effect produced by the inoculation of such poisons depends to a great extent upon the susceptibility of the individual. This is increased by all bad hygienic conditions and above all by the abuse of alcohol and con- sequent visceral disease. When these affections commence apparently spontaneously, careful in- quiry will almost invariably show that the start- ing point has been some local injury occurring in a person previously in ill-health. Simple cutaneous erysipelas, on the other hand, par- takes much more of the nature of an acute specific fever. It is communicable not only by direct inoculation, but by infection; there is a distinct period of incubation, the duration of which is uncertain (variously stated from a few days to two weeks); the constitutional symptoms precede the local inflammation, often by a day or more; and the disease occurs in epidemics. It differs from other acute specifics in its extremely irregular course, and by its not conferring on the patient any immunity from a second attack; in fact, one attack predisposes to another. Two views are therefore held by different authors with regard to it. On the one hand some con- sider it primarily a *general* disorder, the local manifestation of which is a diffuse inflammation starting from any wound that may exist on the person of the patient, or, failing that, choosing by preference the points of junction of mucous membrane and skin On the other hand it is

described as originally a purely *local* inflammation, infective in character, and secondarily giving rise to constitutional disturbance. Others again suppose both forms to exist, and describe them as *traumatic* or *surgical*, and *idiopathic* or *medical* erysipelas. At the present time the question cannot be considered as definitely settled.

Ætiology.—I. *Infection.* Erysipelas is undoubtedly infectious and inoculable, as the experience of hospitals sufficiently teaches us. Its power of infection is, however, not very great, certainly much less than that of measles or scarlet fever, and probably about equal to that of diphtheria. The development of the disease will depend, therefore, to a great extent upon the patient and his surroundings.

II. *Predisposing causes.* A. *In the patient:* 1. Constitutional predisposition. This is said to be increased by a previous attack, and sometimes to be hereditary. 2. Disease of some important viscus, especially liver and kidneys. 3. The presence of a wound. 4. Age. This has little effect; the disease affects all ages alike. 5. Sex. Erysipelas is said to be most common in women, especially at the menstrual period. 6. Intemperance and want of proper food are great predisposing causes.

B. *In the patient's surroundings.* 1. Meteorological conditions. East winds, low temperature, excessive moisture, cold and heat, have all been considered causes. It is said to be most common in spring and autumn. On all these points there is no really reliable evidence.

2. General hygienic conditions. Overcrowding in hospitals, want of ventilation, dirt of all kinds, bad food and impure water are all predisposing causes.

3. Epidemic influences. Erysipelas undoubtedly occurs in epidemics, and the type of the disease often varies in different outbreaks.

We shall now proceed to discuss in detail the several varieties of erysipelas summarised above.

I. Simple Cutaneous Erysipelas.—This is the most typical form of the disease.

Anatomical Characters.—The post-mortem appearances of erysipelas are by no means characteristic. The redness of the inflamed area of course fades after death, leaving a faint yellowish tint. The skin feels hard and inelastic, and the subcutaneous tissue contains an excess of serous fluid. In very acute cases there may be the usual signs of blood-change seen in all malignant fevers—early post-mortem staining, imperfect coagulation of the blood, subserous petechiæ, swollen and soft spleen, and cloudy swelling of the liver and kidneys. Hiller states that microscopic examination of the blood before death shows many of the white corpuscles to have undergone degenerative changes and become converted into masses of highly refracting granules. Busk has described plugs of such altered corpuscles in the small vessels of the lung, and Bastian has observed a similar condition in the vessels of the brain. Microscopic examination of the affected part of the skin shows large numbers of migrating leucocytes, lying in the spaces of the fibrous tissue, amongst the fat-cells, and in the lumen of the lymphatic vessels. They are especially abundant round the small vessels. Lukomsky (Virchow's *Archiv*, Band lxv.) has described the presence of micrococci filling the lymph-spaces and lymphatic vessels at the advancing margin of the erysipelatous inflammation. These are not observed where the rash is receding, nor in those parts which have been affected for any length of time. This observation has been confirmed by subsequent observers.

Symptoms.—In simple erysipelas the constitutional symptoms usually precede the local. The invasion is marked by chilliness, seldom by an actual rigor; loss of appetite; general malaise; nausea, but seldom actual vomiting; headache; pain in the limbs; and the usual signs of pyrexia. The invasion is tolerably sudden. The temperature rapidly rises to about 103° F. or higher. The rarer symptoms at this stage are epistaxis in adults, and convulsions in children. Usually within twenty-four hours of the invasion the characteristic cutaneous inflammation appears. It may, however, commence simultaneously with the febrile disturbance, or be delayed even for two or three days. Frequently the lymphatic glands nearest to the part are swollen before the cutaneous eruption appears; afterwards they are invariably enlarged and tender. The local inflammation usually, if not always, starts from some wound, scratch, or abrasion. It commences indifferently in a fresh wound or a granulating sore. When no wound can be recognised as its starting-point it usually starts from the junction of mucous membrane and skin, most commonly from the corner of the eye, causing a swelling across the bridge of the nose. It may also start from the angle of the mouth, the external auditory meatus, or the anus. It may commence in the nasal fossæ or pharynx, and extend outwards to the skin of the face. Possibly in all cases it starts from some slight abrasion which is scarcely to be detected (Trousseau). The inflamed skin is bright red in colour, with sometimes a yellowish tinge; the redness advances in all directions, but usually most rapidly in that of the lymph-stream. The advancing margin is irregular, sharply defined, and very slightly raised. The cutis is œdematous, and pressure with the finger-nail leaves a deep and abiding mark. Where the subcutaneous areolar tissue is lax, as in the eyelids or scrotum, it also becomes greatly swollen. In the limbs the subcutaneous swelling is great only in severe cases. In many cases small vesicles rise, which may coalesce, forming blebs of considerable size. These ordinarily contain clear yellow serum, which, in bad cases, may be stained with blood-pigment. As these bullæ burst they dry up, forming scabs on the surface, but no ulceration takes place beneath these scabs. The inflammation has but little tendency to end in suppuration; when this does occur it is in those parts in which the œdema has been greatest, as the eyelids. There is heat, tension, and pain in the affected part, and a peculiar sensation of stiffness, which may even precede the appearance of the redness. The febrile symptoms which usher in the attack remain unrelieved so long as the redness continues to spread. The pulse is at first quick and full, but it soon loses force, and in bad cases becomes extremely rapid and feeble. It is by the

pulse, more than anything else, that the gravity of the case is marked. The temperature seldom rises above 106° F., though 107·5° F. has been recorded. The daily variations are not great, there being merely the usual slight morning fall and evening rise. Delirium is not uncommon at night, even in mild cases. In erysipelas of the head it may be a prominent symptom. It is usually due to the blood-condition, and not, as was formerly supposed, to extension of the inflammation to the membranes of the brain. This, however, does occur in rare cases, especially in erysipelas of the orbit or in that following a compound fracture of the skull. The tongue is always foul and usually dry, in bad cases becoming cracked and brown, with sordes on the lips and teeth. In erysipelas of the head the fauces are always red and congested, even when the inflammation has not actually extended to that part. The bowels are sometimes confined, but diarrhœa with offensive motions is liable to occur. There is nothing characteristic about the urine. As in other acute febrile diseases it frequently contains a small quantity of albumen. In erysipelas of the head, when the disease reaches its height, the appearance is often hideous in the extreme, the features being completely obliterated by the swelling of the lax subcutaneous tissue, and the face further disfigured by the scabs formed by the dried blebs. The duration of simple erysipelas is very uncertain. The cessation of the disease is marked by the inflammation ceasing to extend, and by a simultaneous fall of temperature, often very sudden. This may occur as early as the fifth day, or be delayed till the end of the second or middle of the third week. As the rash fades its margin loses its distinct outline, and the redness shades off insensibly. It is not uncommon to see the inflammation spreading at one part, fading at another. After the subsidence of the inflammation there is desquamation of the cuticle, and in erysipelas of the head often complete loss of hair, which is, however, never permanent. Suppuration occasionally takes place in the nearest lymphatic glands. Even after a mild attack the patient's strength is much reduced, and he often remains weak and anæmic for a considerable time. Relapses are by no means uncommon. When death occurs from simple cutaneous erysipelas, it arises most frequently from exhaustion. It may also be due to the gravity of the blood-change. Occasionally the fatal termination is preceded by violent delirium ending in coma. Sometimes it is due to some complication, as pleurisy or pneumonia, or in very rare cases meningitis. When sloughing of the skin or suppuration occurs, death may take place from septicæmia or pyæmia.

Varieties.—Some writers have divided simple erysipelas into *medical* and *surgical*—or *idiopathic* and *traumatic*—and have described these varieties as distinct diseases. They are, however, probably identical, for the following reasons:—they closely resemble each other in mode of invasion, course, and pathological changes; infection from so-called idiopathic erysipelas will give rise to the traumatic form in patients suffering from an open wound; and during an outbreak of erysipelas in a surgical ward patients without open wounds are occasionally attacked by the idiopathic form. Erysipelas has also been subdivided according to the part it attacks, as erysipelas faciei, capitis, scroti, &c.

Erysipelas occasionally affects the mucous membrane of the pharynx and upper part of the larynx. This form presents some peculiarities, and is spoken of as *erysipelatous pharyngitis* and *laryngitis*. The invasion and constitutional symptoms are similar to those of simple cutaneous erysipelas. There is a bright redness of the back of the pharynx and the fauces, always accompanied by considerable œdema of the soft palate and some swelling of the tonsil. The glands at the angle of the jaw are swollen and tender. The danger of this affection arises from extension to the glottis, causing œdema glottidis, with intense dyspnœa, expiration being more easy than inspiration, and both liable to obstruction by spasm. In such cases tracheotomy or laryngotomy may be required at any moment, to prevent death from asphyxia. In other cases the inflammation may extend forwards and appear on the face, either at the nostril or mouth, and afterwards extend as ordinary facial erysipelas.

Erysipelas occasionally attacks new-born infants, starting from the navel or genitals. This form has been spoken of as E. neonatorum. Serous membranes, especially the peritoneum, are said sometimes to be affected by erysipelas following wounds. In lying-in women the poison of erysipelas seems, in common with that of many other unhealthy inflammations, to be capable of causing puerperal fever.

Dermatologists have, according to their wont, invented a name for every possible variation. Thus when the inflammation spreads at one part while fading at another it has been called E. ambulans or erraticum; when spreading in a winding course, E. serpens; when causing small vesicles, E. vesiculare or miliare; when blebs form, E. bullosum; when there is much swelling, E. œdematosum, &c. Such names are useless, and may be multiplied *ad infinitum*.

Diagnosis.—When the eruption is fully developed it is scarcely possible to mistake the disease, During the stage of invasion, before the appearance of the rash, diagnosis is impossible. Simple diffuse inflammation round a wound or abscess is distinguished from erysipelas by the absence of the characteristic invasion, and of the sharply defined border. Simple erythema differs from erysipelas in the absence of fever, and in the eruption being composed of numerous isolated patches. Occasionally, in malignant small-pox, there may be much redness and swelling of the face before the appearance of the vesicles, but the symptoms of invasion are much more severe than those of erysipelas.

Prognosis.—The prognosis depends chiefly upon the gravity of the general symptoms. The following are bad signs:—high fever, violent delirium, excessive diarrhœa, early prostration, and very dry tongue with sordes. The extent of the inflammation is of less importance. Old age, disease of the kidneys or liver, and especially chronic alcoholism, add greatly to the gravity of the case. When erysipelas affects the pharynx there is always danger from œdema glottidis. In uncomplicated cases the death-rate is not high.

Of 25 cases treated in the medical wards of University College Hospital from 1872 to 1876, only one died, and he was suffering from chronic Bright's disease.

Treatment.—1. *Constitutional.* Erysipelas being a most exhausting and depressing disease, no antiphlogistic treatment is ever justifiable. Clear the bowels at the commencement of the attack, but avoid violent purgation. Only two drugs have any reputation in the treatment of erysipelas. The tincture of perchloride of iron, in large and repeated doses, has been strongly recommended by Dr. Reynolds and others, and is stated by some to act as a specific. To be of any use it must be given in doses of forty minims every four hours. Aconite if administered as soon as the temperature begins to rise is said to cut the attack short. It may be given in half-minim or minim doses of the tincture, at first every quarter of an hour for one or two hours, and afterwards hourly till the skin becomes moist and the temperature falls, but its effects must be very carefully watched, to avoid dangerous depression. The *diet* must be as nourishing as possible; beef-tea, eggs and milk, &c. Solid food can never be taken during the advance of the disease. Stimulants are usually required, and the amount must be regulated by the pulse. Large quantities are often necessary.

2. *Local.*—Local treatment is very various. Warmth and avoidance of variations of temperature are essential. Cold is utterly inadmissible; it aggravates the inflammation, and tends to cause suppuration or even sloughing. Hot fomentations or hot baths may be employed when the part affected renders them admissible. In other cases dry warmth must be used; it is best obtained by covering the affected part with a thick layer of cotton wool. Poultices should be avoided, as they needlessly irritate the skin, and are dirty and apt to get cold. With the application of warmth innumerable varieties of local applications have been recommended. These may be divided thus:—(*a*) *Indifferent applications.* These are intended only to exclude the air, but they have the disadvantage of shutting in the secretion of the skin. The most common of these are collodion, oil, and a thick layer of flour or starch under cotton wool. (*b*) *Sedative applications.* The most important remedy of this class is belladonna. It is best applied as a paint composed of equal parts of the extract and glycerine. It is especially useful when there is much inflammation of the lymphatic vessels and glands. (*c*) *Powerful Astringents.* Valette of Lyons recommends a 30 per cent. solution of perchloride of iron; Higginbottom a solution of the 'brittle stick of nitrate of silver' 20 grains to one drachm of water. Before applying either of these the skin must be carefully washed with soap and water to free it from grease. The perchloride of iron must be rubbed in with a glove. (*d*) *Antiseptic applications.* Marshall recommends creasote made into a paste with kaoline; Dewar, equal parts of sulphurous acid (B.P.) and glycerine; tincture of iodine is a common application. Lately Hueter has practised the subcutaneous injection of a 30 per cent. solution of carbolic acid. He states that this causes an immediate arrest of the inflammation for a small distance round the puncture; if, therefore, the treatment is adopted at so early a stage that the area of inflammation can be surrounded by four or five punctures the disease may be checked. Beyond this there would be danger of carbolic acid poisoning. (*e*) *Drawing a limiting line* in front of the advancing rash. This has been done with solid nitrate of silver and with blistering fluid. It is utterly useless.

Erysipelas of the fauces is best treated by the local application of a strong solution of perchloride of iron. If there is œdema glottidis the swollen parts must be scarified, and if that fails to give relief, tracheotomy may be necessary.

II. **Phlegmonous or Cellulo-cutaneous Erysipelas** was described by Dupuytren under the name of 'diffuse phlegmon.'

Anatomical Characters. — Incisions made into the inflamed part in the early stages show the spaces of the areolar tissue distended with serous fluid; a little later on the fluid is found to be turbid, resembling thin pus; later still the subcutaneous cellular tissue is represented by masses of shreddy sloughs soaked in a puriform fluid. Unless exposed to the air by incisions or by sloughing of the skin these sloughs are free from any odour of decomposition and contain no gas. There is nothing characteristic in the post-mortem appearances of the internal organs.

Symptoms.—The invasion is usually marked by chilliness or a rigor, elevation of temperature, nausea, headache, and general malaise. The local inflammation may commence in some wound or abrasion, but it may also arise spontaneously. From the beginning there is marked œdema of the subcutaneous tissue. The skin is reddened, but the margin of the redness is not sharply defined, and swelling and tenderness of the lymphatic glands is often absent. As the area of inflammation extends, the affected part becomes tense and brawny, and vesicles or large blebs form. The tension may become so great that firm pressure with the finger scarcely makes any impression. In a few days from the commencement of the disease, the greater part of a limb may be involved. If unrelieved by treatment the tint of the redness becomes more dusky, and dark purple patches appear. At the same time the tension becomes less, and gives place to a soft, boggy feeling, indicating sloughing of the subcutaneous cellular tissue. Then livid patches appear, which break down into sloughs. As these sloughs separate, large shreddy masses of gangrenous cellular tissue can be drawn out, leaving the undermined skin connected with the deeper parts only by bands containing the larger vessels. Finally, the remaining skin being insufficiently nourished may thin and melt away, leaving large tracts of the fascia and muscles beneath exposed to view. In this way if proper treatment be not adopted in time, the greater part of a limb may be denuded of its cutaneous and subcutaneous covering. The extreme stage may be reached in a week or ten days, but a longer time usually elapses before all the sloughs are separated. In the earlier stages there is much burning and tensive pain, but this subsides as gangrene sets in. The constitutional symptoms are grave from the beginning. There is high fever, the thermometer often

reaching 105° F. The tongue is dry and brown, and sordes accumulate on the lips and teeth; there is total loss of appetite; and diarrhœa is a frequent symptom. The pulse, at first full and bounding, soon loses force, becoming rapid and weak. Delirium, usually of the muttering type, is always present in severe cases. Death occurs from exhaustion or from some complication, such as pneumonia, pleurisy, &c. During the separation of the sloughs septicæmia and pyæmia are of frequent occurrence. The disease most commonly attacks one of the limbs, but it is occasionally seen in the scrotum, and a peculiarly virulent form has been described as affecting the face. Phlegmonous erysipelas most commonly occurs in adult patients of broken constitution, suffering usually from the effects of the abuse of alcohol, or from some disease of the liver or kidney.

Diagnosis.—From simple erysipelas the phlegmonous form is distinguished by the great swelling and brawny hardness, by the want of a sharply defined edge, and by the early tendency to sloughing; from spreading gangrene by its slower progress, and the absence of the rapid decomposition and development of gas in the tissues. Acute necrosis somewhat resembles it, but this disease is limited to young subjects, the swelling is less brawny, and when pus forms there is distinct fluctuation and not the boggy feeling of phlegmonous erysipelas.

Prognosis.—The prognosis is always grave, especially if there is any delay in adopting the proper treatment. Early failure of the heart's force, excessively dry tongue, diarrhœa and vomiting are bad signs. The gravity of the case increases directly with the area affected.

Treatment.—The patient must be supported by good beef-tea, milk and eggs, and stimulants are usually required to be freely given. No depletory measures are ever justifiable. Ammonia-and-bark is sometimes of service. *Locally* the treatment in very mild and doubtful cases must consist in the application of hot fomentations, and extract of belladonna made into a paint with an equal amount of glycerine. As soon as there are any signs of tension, free incisions must be made to relieve it. The patient's danger will be greatly lessened if these are made with all the precautions of Lister's antiseptic method.

III. Diffuse Cellulitis, or Cellular Erysipelas.—In this disease the inflammation is confined to the subcutaneous cellular tissue, or to the planes of areolar tissue amongst muscles or beneath fasciæ. The course of the inflammation is similar in many respects to that of phlegmonous erysipelas, the only important difference being that the skin remains unaffected, or is only implicated in the later stages as a consequence of the sloughing of the subcutaneous tissues.

Anatomical Characters.—The post-mortem appearances are similar to those of phlegmonous erysipelas.

Symptoms.—The local signs of diffuse cellulitis when occurring in the subcutaneous tissue or beneath the superficial fascia, are marked œdematous swelling, gradually becoming brawny, slight redness of the skin, and usually mottling from over-distension of the superficial veins. There is no sharp limit to the swelling. There is intense tensive or burning pain, increased by movement, and acute tenderness on pressure. The neighbouring lymphatic glands are in most cases swollen and tender. As the disease advances, the swelling becomes doughy, and possibly an indistinct sensation of fluctuation may be felt. The skin now becomes redder, and the gangrenous inflammation may even extend to it, unless prevented by treatment. An incision in the œdematous or brawny stage merely shows the areolar spaces distended with serum, sometimes clear, more often turbid. If the incision be delayed till the later stages the affected cellular tissue is reduced to a mass of shreddy sloughs soaked in pus. Gas does not form amongst these sloughs till after air has been admitted from without. In mild cases the inflammation may localise itself, and lead to the formation of a large abscess. The constitutional symptoms are always grave. The temperature is high, 104° to 106° F. There are the usual symptoms of fever; the tongue is foul and speedily becomes dry; vomiting and diarrhœa are not uncommon; the pulse, at first quick and full, soon becomes feeble and rapid. There is almost always delirium. The disease usually runs a rapid course, two or three days sometimes being sufficient for it to reach its extreme stage.

Diffused cellulitis, as above described, is most frequently the result of a poisoned wound; it may then start from the wound or make its appearance at a distant part. It forms the most fatal variety of post-mortem wound; and, as is well known, in such cases the puncture may appear healthy, whilst the areolar tissue in the pectoral region may be the seat of most acute diffuse inflammation. The bite of the less poisonous reptiles causes a similar diffuse inflammation. Diffuse cellulitis of the pelvis is a common cause of death after lithotomy, and is not uncommon in women after labour. Diffuse cellulitis beneath the pericranial aponeurosis is of frequent occurrence after scalp wounds. Occasionally the disease arises spontaneously, and it is then most common in the upper limb, but it has been seen in the areolar tissue of the neck and in many other regions. In pyæmia and septicæmia patches of diffuse cellulitis may appear in intermuscular spaces, or in the subcutaneous tissue.

Diagnosis.—The diagnosis of cellulitis is often difficult when the mischief is deep-seated. The œdema, pain, and tenderness, with the severe constitutional symptoms, are the chief guides; but even when these are well marked, the extent of the inflammation, and the necessity for active treatment are often difficult to determine.

Prognosis.—This depends much upon the cause and upon the previous health of the patient. It is a very bad sign when the gravity of the general symptoms is out of proportion to the local mischief. In the pelvis cellulitis may be fatal from peritonitis; in the neck it is very fatal; it is much less dangerous in the limbs. When it occurs as a part of pyæmia or septicæmia the prognosis is of course very grave.

Treatment.—Early incisions into the inflamed cellular tissue, with antiseptic applications, and abundant support, form the only reliable treat-

ment in severe cases. In slight cases the application of extract of belladonna and glycerine (equal parts), with hot fomentations, may lead to resolution or limitation of the inflammation.

IV. **Erysipelatous Lymphangitis.** — Inflammation of the superficial lymphatic vessels is a common accompaniment of all varieties of erysipelas; but in some cases it forms by far the most prominent local morbid condition.

Symptoms.—This affection is characterised by red lines running in the course of the lymphatic vessels from some local sore or wound. The lines are at first tolerably sharply defined, and about a quarter of an inch in width, but after a short time they spread out and several may coalesce, forming a patch exactly resembling simple cutaneous erysipelas. There is slight œdema, some pain and stiffness, and acute tenderness on pressure. The lymphatic glands to which the vessels lead are swollen and tender. The constitutional symptoms are the same as in simple erysipelas.

Diagnosis.—This affection can only be mistaken for phlebitis, but the diagnosis is easily made by observing the course of the lines, and by the absence of the knotted cord formed by the coagulation of the blood in an inflamed vein.

Treatment.—The treatment is the same as in simple erysipelas. The extract of belladonna and glycerine is especially useful in this form of erysipelatous inflammation.

V. **Erysipelatous Phlebitis.**—Inflammation of the superficial veins, rapidly spreading in the course of the circulation, accompanied by thrombosis, redness of the skin, and acute tenderness, has been supposed by some authors to be erysipelatous in character. The only evidence in favour of this view is that the invasion and the constitutional symptoms resemble those of erysipelas, and that the affection is not uncommon during epidemics of erysipelas. *See* Veins, Diseases of.

Various other diseases have been classed as erysipelatous: the chief of these are whitlow, some forms of puerperal fever, and diffuse peritonitis after operations affecting the peritoneum; all these will be described elsewhere. Diffuse inflammation not unfrequently occurs after punctures made to allow of the escape of the fluid in the dropsy of Bright's disease. That punctures made into feebly nourished tissues bathed in decomposable serous fluid should set up diffuse inflammation is not surprising, but evidence is wanting to prove that such inflammation is necessarily connected with erysipelas.

Marcus Beck.

ERYTHEMA (*ἐρυθρὸς*, red). Synon.: *Rose-rash*; Fr. *Érythème*; Ger. *Hautröthe.*

Definition.—A non-infective superficial inflammation of the skin, the essential characteristic of which is redness, which disappears on pressure by the finger, reappearing when the pressure is removed. The hue may vary from a bright rose to a dark blue red; it may or may not be accompanied by swelling; the part may be hotter than natural; and the appearance may present itself as spots, circumscribed or diffuse, or as wheals. It is sometimes attended by a sensation of slight burning or itching, but generally gives rise to no subjective symptoms. After it has disappeared the skin is either normal, or remains slightly pigmented, or desquamates. Generally there is an increase of temperature, with slight feverish symptoms. Erythema may be either *symptomatic* or *idiopathic.*

a. **Symptomatic Erythema.**—Ætiology and Varieties.—Erythema occurs in rare instances after the administration of drugs. Cases are recorded after the ingestion of arsenic, belladonna, chloral, copaiba, cubebs, digitalis, iodides, opium, quinine, salicylic acid, stramonium, strychnia, and turpentine. The rash usually appears immediately after the absorption of the medicine into the circulation; after arsenic it appears at a later period.

Exposure to heat or cold, and contact with various acrid or poisonous substances are also common causes of erythema. Friction and, in the absence of cleanliness, the secretions of the skin itself, may give rise to it, as when *erythema intertrigo* is produced between the scrotum and thighs by the irritation of profuse sweat and sebaceous secretions. The blush of shame and anger is an erythema produced by the immediate action of the vaso-motor nervous system.

Variola, cholera, enteric fever, rheumatic fever, and various other less distinctly defined febrile conditions, are frequently accompanied during various stages of their course by a more or less generally diffused and mostly ephemeral form of erythema.

The *roseola infantilis* of authors is an erythema that accompanies intestinal disturbance, teething, and various other disordered conditions of the system in children. Its appearance may exactly simulate that of measles or scarlatina, but it differs from these in disappearing in less than twenty-four hours, and in leaving no desquamation behind it.

The erythema that accompanies small-pox —*roseola variolosa*—appears generally on the second day of the disease, either as a diffuse redness of the whole integument, or as bright red spots, which are seen first on the face and then on other parts of the body. It lasts from twelve to thirty-six hours, and disappears when the small-pox eruption begins to show itself. A special limited form of erythema has been observed on the second and third days of small-pox, extending from the hypogastrium down the front of the upper two-thirds of the thighs; the affected surface, when the legs are closed, having the form of a triangle the base of which is across the lower part of the abdomen. This surface remains almost or entirely free from the variolous pustules, and many of the cases in which it is present end fatally.

From the third to the eighteenth day after vaccination, small or large erythematous patches —*roseola vaccina*—are sometimes seen, generally on the arms, but also on other parts of the body. They usually disappear within twenty-four hours, and leave neither desquamation nor pigmentation.

The forms of erythema mentioned above cannot be considered as being in themselves specific varieties of disease, and pathologically consist in a temporary injection of the capillary blood-vessels of the skin. They are to be distinguished from the erythemata that run a distinct course, terminating in pigmentation and desqua-

mation, and in which the capillary injection is accompanied by exudation.

b. Idiopathic Erythema.—I. *Erythema multiforme.*—This form of idiopathic erythema is most commonly seen in spring and autumn, and is distinguished by its localisation. It begins on the backs of the hands and feet, and frequently is found in these situations only. In some cases it extends upwards to the shoulders and hips, and in very rare cases is also found on the trunk.

The appearance consists in flattened papules from the size of a pea to that of a bean, of a dark blue or brown-red colour. They are surrounded on their first appearance by a red zone which soon disappears, and the border of the papule then stands out in fuller relief. The mildest form of this disease consists in papules which disappear after a few days—*erythema papulatum* seu *tuberculatum.* Instead of thus disappearing it may spread outwards from the edge, and flatten and become pale in the centre, thus forming a red ring, the condition being known as *erythema annulare.* While the first circle persists a second ring may form round it, and the circles may be constituted by small papules, forming the condition recognised as *erythema iris* seu *mamellatum.* Another stage may be reached by the enlarging circles meeting, and so forming segments of a circle, constituting the form known as *erythema gyratum* seu *marginatum.*

At any of these stages the eruption may disappear. The sequlæ are slight pigmentation and desquamation.

The disease, whose different stages have received the different names above indicated, has been designated, on account of the different forms under which it may be seen, *erythema exsudativum multiforme.* It is accompanied by a slight feeling of burning, or by very slight itching. Constitutional symptoms are only present exceptionally, and when the eruption is universal. Hebra relates that in a woman who died whilst an eruption of *erythema gyratum* was on the skin, similar red rings were found in the small intestine. It is most common in adolescence, and is more frequent in males than in females.

II. *Erythema nodosum.*—This name is given to a disease characterised by the appearance on the skin, and chiefly on that of the lower extremities, of pale red hemispherical or oval swellings. These vary in size from that of a pea to that of a hen's egg, and are painful on pressure. Fever is sometimes present.

The swellings are at first pale red with a yellowish tinge, later dark red, and finally livid; after they disappear they leave behind them a yellow pigmentation similar to that which follows a contusion. The number of swellings may vary from a very few on the lower extremities to successive crops on different parts of the limbs and trunk. In the latter case the feverish symptoms are well-marked. The course of the disease is completed in two to four weeks. The swellings never suppurate, never itch, are always painful, and the redness never spreads to the adjoining skin. This variety can occur in combination with the previously described forms of *erythema multiforme.* It is a disease of childhood and adolescence, and is chiefly seen in females.

Prognosis.—The prognosis of the special forms of erythema—*multiforme* and *nodosum*—is always favourable. Those varieties seen in the course of other diseases do not modify the prognosis of the particular disease which each accompanies.

Treatment.—The treatment of erythema consists in palliating the attendant symptoms. Dusting with flour, or the application of spirit-lotion, should be employed when productive of a sense of comfort to the patient. In *erythema nodosum* warm applications of infusion of poppies or chamomile are soothing; while aperients, and, when fever is present, gentle diaphoretics may be given internally. In many such cases tonics, especially quinine, are required.

George Thin.

ESCHAROTICS (ἐσχάρα, a slough).

Definition.—Escharotics are substances that completely destroy the tissues to which they are applied, and produce a slough. They are distinguished from other caustics simply by the greater intensity of their action.

Enumeration.—The chief escharotics are:—The hot iron, Sulphuric Acid, Nitric Acid, Potash, Chloride of Antimony, Chloride of Zinc, Acid Nitrate of Mercury, Bromine, Chromic Acid, and Lime. Weaker caustics are—Nitrate of Silver, Sulphate of Copper, Sulphate of Zinc, Iodine, Carbolic Acid, Arsenious Acid, Sulphide of Arsenic, and Dried Alum.

Action.—Escharotics combine with the tissues and destroy them. Around the part thus killed inflammation is set up, and the part is separated as a slough. Besides their local action these agents act reflexly on other parts of the body through the nerves of the region to which they are applied.

Uses.—Escharotics are employed, first, to destroy the virus in, and the tissues around, a poisoned wound, and thus prevent the absorption of the poison, for example, in bites by snakes or rabid animals, or in cases of inoculation with syphilis, or with animal-poisons in dissection or post-mortem examinations. Secondly, they are used to destroy unhealthy tissue, such as exuberant granulations, and to remove excrescences and morbid growths, as warts, condylomata, nævi, polypi, hæmorrhoids, and cancer. Thirdly, they are used to open abscesses, especially those of the liver. For this purpose caustic potash is usually employed. Lastly, by means of escharotics it is usual to establish issues, and thus react beneficially on distant organs.

T. Lauder Brunton.

ESSENTIAL PARALYSIS.—A synonym for infantile paralysis. *See* Infantile Paralysis.

ETHER, Uses of. *See* Anæsthetics.

ETIOLOGY. *See* Disease, Causes of.

EUSTACHIAN TUBE, Diseases of. *See* Ear, Diseases of.

EUSTRONGYLUS GIGAS. *See* Sclerostoma.

EVACUANTS (*evacuo*, I empty).—Definition.—Medicines used to produce some evacuation from the body.

Enumeration.—The chief evacuants are:—Sternutatories, Expectorants, Sialagogues, Emetics, Cholagogues, Purgatives, Diaphoretics, and Diuretics. *See* the several articles upon these subjects.

EXACERBATION (*exacerbo*, I make violent).—Increase in the severity of the symptoms of a disease.

EXANTHEMA, EXANTHEMATA.—(ἐξ, out, and ἀνθέω, I blossom).—Synon.: Fr. *Exanthème*; Ger. *Ausschlag.*

Definition.—A rash or eruption on the skin.

The use of this term, once denoting any cutaneous eruption, is now restricted to the eruptive fevers called the *exanthemata.* Dermatologists discriminate the febrile rashes or exanthems of local or individual origin—urticaria, erythema, and roseola—from the true exanthemata, which are acute specific infectious diseases, namely, Typhus, Variola, Varicella, Morbilli, Rötheln, Dengué, Scarlet Fever, Typhoid or Enteric Fever, and perhaps Erysipelas. In this article some leading features of these diseases will be shortly stated; and, as each of them will be found fully discussed under their several heads, it is only necessary further to notice certain less defined and regular eruptions associated with fever.

All the exanthemata are attended with fever and enlargement of the lymphatic glands.

Typhus.—The mulberry rash appears suddenly on the fourth and fifth days of illness as a dull red mottling of irregular, persistent, non-elevated spots; the fever, high at the commencement, continues so after the rash is fully developed.

Typhoid.—In typhoid fever the small, raised, rose-spots do not appear till the second week of fever; sparsely scattered on the trunk, they fade on pressure, disappearing in three or four days, while new spots arise.

Small-pox.—Marked fever of sudden ingress occurs two days before the raised eruption; sometimes a rose rash first appears, but the severe symptoms begin a full day before this and not more than two days before the characteristic spots appear. The cervical glands are enlarged.

Varicella.—The eruption begins on the first day of illness; the fever is often high and comes on suddenly, but enlarged cervical glands and spots somewhere are always to be found at the same time.

Measles.—Three days of fever and catarrh, with palpable enlargement of the cervical glands, precede the rash; there is then sudden increase of fever, subsiding while the rash is at its height.

Rötheln; Rubeola sine catarrho.—The rash appears within a few hours of the first feeling of illness, which is slight and soon over. The rash is at first spotted rather than finely diffused. By the time it is fully out the fever has subsided, but the enlarged cervical glands which marked the ingress always remain to indicate a specific disease; fine desquamation rarely follows, and there is no albuminuria. Rötheln is invariably transmitted by contagion, the incubation being from two to three weeks; this long period of incubation causes the source of infection to be often overlooked, and even the possibility of it to be denied; when carried to a family or school either an unnecessary alarm of measles is raised, or the next sufferers are said to have all drunk cold water together after being heated.

Dengué.—Widely-spread in Africa, the warmer parts of America, and both the Indies, dengué may possibly be limited to hot climates; its presence with us is as yet undetermined. The rash is at first discrete, like that of measles, but follows soon after infection, and the disease in its general course is allied to scarlet fever.

Scarlet Fever.—The finely diffused redness is found on the skin and in the mouth and throat often within a few hours of the sudden ingress of fever; the fever increases with the development of the rash, both persisting for several days. Often the throat is first complained of; the glands at the angle of the jaw are full and tender. Scarlatina is often declared three or four days after surgical operations. The skin is not swelled as in erysipelas, nor the redness so circumscribed; the throat also is redder; the cervical glands are enlarged in both.

Epidemic Roseola. — An epidemic roseola, having such relation to scarlet fever as rötheln to measles, has but slender claim to autonomy. Mild cases of scarlet fever often begin with a finely-diffused redness shortly after some feeling of faintness or giddiness; an incubation of from three days to a week is observed; sometimes albuminuria occurs as an early symptom. The finely-diffused rash, enlarged cervical glands, and slight sore-throat, even with very little elevation of temperature, raise the suspicion of scarlet fever; should albuminuria follow, or any shreddy desquamation of the hands and feet, no uncertainty remains. Scarlet fever so modified often spreads and gives rise to the severer forms of the disease when it has been called only rose rash or roseola; the use of these terms without a distinctive qualification always leaves a doubt as to the completeness and safety of the diagnosis.

Erythema comes nearest to these cases in appearance, so near as often to be spoken of as recurrent scarlet fever or erysipelas, but there is no enlargement of the cervical glands in erythema, and so little fever that the temperature of the reddened skin is barely elevated above the normal. Since Fuller's *Exanthematologia* this kind of flush passes under different names of roseola, according to the variations in shape of the red patches, or the seasons of the year at which they occur.

Erythema nodosum is often preceded by slight fever for a day or two; this may reach 102°, but subsides as the red swellings appear; locally there is little or no elevation of temperature even when the tender part feels hot.

Exanthematous Roseola occurring in the course of other specific diseases is distinguished from the roseola which depends on nerve-irritation, caused, for example, by acrid ingesta, by the presence either of high fever, or of glandular enlargement, or of both, as when it precedes the true variolous eruption. During enteric fever this form of roseola may occur quite independently of the special lenticular rose-spots.

An eruption of this kind is not infrequent in the early stages of diphtheria, sometimes as a

diffused rash limited to certain parts of the chest and body, or as discrete spots on the limbs and back of the hands and feet. Influenza, and some forms of catarrh, winter 'colds,' or summer diarrhœa as noticed by Bateman, may begin with punctiform roseola on the back, shoulders, and chest; the cervical glands are perceptibly enlarged, though there may be little fever. In these cases it is not the roseola, but the specific disease on which it depends, that might, without precautions, be communicated to others.

Syphilitic Roseola.—A special roseola marks the secondary stage of syphilis; in appearance it resembles the rash of measles; so does the *roseola ab ingestis* when produced by cubebs, but this has neither fever nor glandular enlargement.

The absence of fever from the roseola after vaccination refers this form of eruption, like that occurring from dentition, to the class of rashes from nerve-irritation. *Vaccinia* is itself an exanthem in the wider definition of the term, reproduced after a definite period of incubation by inoculating a special contagium. Wanting this character the different forms of herpes are excluded, though resulting from a general febrile disturbance; though inoculable, ecthyma and impetigo are local affections not belonging to the exanthemata. WILLIAM SQUIRE.

EXCITANTS (*excito*, I excite).—It seems hardly necessary to give any special consideration to this therapeutical class, as all that may be said on the subject ranges itself with greater propriety under the heading STIMULANTS. Stimulation is, in fact, a degree of excitement, and it is only when its effects are more vigorously pushed that we obtain that inebriation or exhilaration which is so commonly observed to follow the use of alcohol, ether, and the anæsthetic vapours. *See* STIMULANTS. ROBERT FARQUHARSON.

EXCITING CAUSE. *See* DISEASE, Causes of.

EXCITO-MOTOR Disorders. *See* REFLEX DISORDERS.

EXCORIATION (*ex*, from, and *corium*, the skin).—The superficial destruction of a portion of the skin or mucous membrane.

EXERCISE.—DEFINITION.—In its widest and most correct signification, exercise is the setting in motion any active body; and when the term is used in a physiological connection, it may refer to the functional activity of any of the organs, whether muscular, nervous, nutritive, secretory, or reproductive. In this very comprehensive sense, the subject of Exercise includes a large portion both of hygiène and of therapeutics. The popular signification of Exercise is, however, much more limited than the preceding, having reference only to the muscles directly, and to the parts called into play through the same—especially the circulatory and respiratory systems.

Whether in its wider or in its narrower sense, exercise has several important relations to Medicine. 1. It is essential to the preservation of health (*see* PERSONAL HEALTH). 2. It has to be regarded as frequently associated with the causation of disease (*see* DISEASE, Causes of). 3. Exercise is a most rational and successful means of treatment in certain disorders and diseases (*see* MOVEMENT, Therapeutics of). 4. Exercise is often abused; and excessive indulgence in some forms of it gives rise to serious consequences. The present article will be devoted to the consideration of Exercise in the last-named aspect only; and the subject will be discussed according to the more limited and popular definition of the term.

Abuse of Exercise.—From the moment an infant is born until the end of life, exercise, duly apportioned to rest, is the normal state of existence; and whilst continued overstrain of any portion of the human machine is the forerunner of disease, so, on the other hand, is equally, if not more so, that want of exercise which induces wasting and degeneration.

PRINCIPLES. — Dr. Parkes, in his *Practical Hygiene*, has given a very complete statement of the results of the investigations of himself and others on the changes effected by the stimulus of muscular exercise on the various organs and tissues of the body, from which he has drawn the following conclusions:—

'The main effect of exercise is to increase the oxidation of carbon, perhaps also of hydrogen. It also eliminates water from the body, and this action continues—as seen from Pettenkofer and Voit's experiments—for some time; after exercise the body is therefore poorer in water, especially of the blood; it increases the rapidity of circulation everywhere, as well as the pressure on the vessels, and therefore it causes in all organs a more rapid outflow of plasma and a more active absorption—in other words, a quicker renewal.

'In this way, also, it removes the product of their action which accumulates in organs; and restores the power of action to the various parts of the body. It increases the outflow of warmth from the body by increasing perspiration. It therefore strengthens all parts. It must be combined with increased supply both of nitrogen and carbon (the latter possibly in the form of fat), otherwise the absorption of oxygen, the molecular changes in the nitrogenous tissues, and the elimination of carbon, will be checked. There must also be an increased supply of salts, certainly of chloride of sodium, probably of potassium phosphate and chloride. There must be proper intervals of rest, or the store of oxygen, and of the material in the muscles, which is to be metamorphosed during contraction, cannot take place. The integrity and perfect freedom of action both of the heart and lungs is essential, otherwise neither absorption of oxygen, nor elimination of carbon, can go on, nor can the necessary increased supply of blood be supplied to the acting muscles without injury.'

The proper amount of exercise requisite for health is difficult to determine, in consequence of the varied constitutions of individuals. It may, however, be accepted that whilst in youth the great spirit of emulation tends to an overstrain of mind or body, so, as life advances, one or other or both are liable to be allowed to pass into a state of unhealthy inactivity.

Since the recent more general practice of

gymnastics in this country, and the stimulus that has been given to aquatic exercises by our University competitions, great attention has been drawn to the effect of bodily exercise on health, and more especially with regard to the heart and lungs, these being the organs upon which its influence is most immediately exerted.

a. Prolonged and Excessive Exercise.—Of all exercises, rowing is the one which is generally accepted as the best variety to select if we are to endeavour by a consideration of its influence upon those who practise it to form an estimate of the effect of a continuous strain on the circulation and respiration; yet the difficulty of procuring trustworthy evidence on such a subject is extreme. Dr. Morgan, in his *University Oars*, by collecting the various experiences of nearly all the men who rowed in the University races from 1829 to 1869, has obtained about the most accurate testimony available in regard to one aspect of the subject. These men are unanimous in their belief that they experienced no injury from the great strain they underwent in their youth. But it must be borne in mind that they were the picked athletes of their colleges, men with large frames and full chests, typical specimens of health, capable of undergoing very prolonged exertion with but passing fatigue, and to whom no permanent injury could be anticipated, after careful training, from an exceptional display of strength. Such evidence affords no clue to the effect of the strain imposed on the heart by the two hundred or more of each University, who annually use the utmost exertion to belong to the chosen few, and many of whom, unguided in their violent efforts to achieve success, have in after-life to pay the penalty of allowing mere feeling or spirit of emulation to overrule their reason.

b. Exercise under Unnatural Conditions.—But it is not only the case that exercise which is excessive or too prolonged proves highly deleterious; even a moderate amount of exercise under unnatural conditions may prove equally harmful. Thus the young soldier of light frame, with irritable palpitating heart, who has broken down in his preliminary training, is a marked and good example of the early injurious effect of overstrain of the heart, under the impediment caused by tight clothing and accoutrements to the free expansion of his chest. When at rest he feels perfectly well, and has little or no sensation of throbbing in his chest. So soon, however, as he puts on his tunic and accoutrements, and begins his drill, throbbing occurs with more or less violence, accompanied with a feeling of oppression, and with difficulty of breathing, and this being followed by a sensation of faintness, sickness, or dizziness, he has to fall out of the ranks. At first the condition of the heart is one purely of functional disturbance, which, though rendering him unfit for the duties of a soldier, does not interfere with his gaining his livelihood as a civilian.

This functional derangement of the heart, which is readily shown by the dicrotism in the sphygmographic tracing of the radial pulse when auscultation can detect little or no change in the heart-sounds, is frequently found in those youths of delicate frame in our schools and colleges, who, 'breaking down' in attempting feats of strength or in the preliminary training, experience no ill-effects in the ordinary avocations of after-life from that overstrain of heart which, if neglected, would be apt to lead to graver forms of heart-disease.

Whether it be by sudden or prolonged violent exertion, by rowing, or by running, or by the many other severe exercises of the body entailed by labour or pleasure, there can be no doubt that the heart and lungs have at times an inordinate amount of strain forced upon them, which, in a state of health, or under favourable circumstances, they may reasonably be expected to bear with no more injury than temporary distress, and that this capability to bear strain is greatly enhanced by careful training.

It is customary for the healthy boy, however, owing to the character of his amusements, always to be in training, so far as his body is concerned, and with very little supervision he ought to suffer no harm from sudden and exceptional strains. But it is very different with men who have settled down into the real business of life, but who, during their nominal periods of rest from their daily labours, undertake violent exercises without any preliminary training, and thus throw such an unexpected strain on the heart and great blood-vessels, that instead of mere functional disturbance, as in early life, they sow the seeds of organic disease. Such being the case, how much more injurious must sudden overstrain be to a heart already weakened by disease? There is often found amongst men a great aversion to having their hearts examined, and when disease is discovered it is sometimes considered of questionable advantage to inform the sufferer of his condition; but this is a mistake, for from want of knowledge of his state he may, by unnecessary strain, rapidly aggravate it, and thus shorten a life which might otherwise have been much prolonged.

The purport of these observations is thus to point out that:—Firstly, whereas exercise is necessary to preserve our bodies in a proper state of healthy activity, its tendency, when carried to extremes, is to set up organic lesions. Secondly, that as in some athletic competitions a very great strain is thrown upon the thoracic organs, it is essential that no boys of delicate frame should be allowed to take part in them, or in the preliminary training, excepting under careful medical supervision. And, thirdly, that in manhood no violent competition should be undertaken, which would throw a great strain upon the thoracic organs, without their being previously examined and pronounced sound, nor until their full powers have been brought into play by careful preliminary training.

A. B. R. Myers.

EXFOLIATION (*ex*, from, and *folium*, a leaf).—The separation of a portion of dead bone or cartilage from the living tissue, in the form of layers (*see* Bone, Diseases of). The term is also applied to the separation of a false membrane which has been mistaken for the whole mucous lining of the bladder or uterus. *See* Bladder, Diseases of.

EXHAUSTION (*ex*, from, and *haurio*, I draw out).

Definition. — Exhaustion is a phenomenon which all irritable tissues can be made to manifest, and consists in a failure to respond to stimulation. Exhaustion of muscle and nerve is brought about by excessive, quickly repeated, or continuous stimulation. It is favoured by cutting off, or by an alteration in the quality of, the blood-supply; by previous insufficient exercise of function; by exposure to extremes of temperature; by an insufficient supply of oxygen; by an excessive supply of carbonic acid; and by exposure to certain toxic agents. These facts, which have been established by physiological experiments, are fully borne out by clinical experience.

Exhaustion may be *general* or *local*.

1. **General Exhaustion.**—General exhaustion is brought about by over-work, whether physical or mental, and especially by unremitting and monotonous duties which keep the same paths of action in a state of constant activity. It is not often, if ever, that any permanent harm is produced in a healthy man by mere physical labour, however great; but excessive mental labour, especially if it be monotonous, is certainly capable of permanently damaging the nervous tissues. When in addition to hard mental work, which is performed voluntarily, some constant stimulus, which cannot be arrested, unceasingly works upon the brain, exhaustion quickly results; as when, for example, a man who is harassed by trying to earn sufficient for his family meets with some shock to his nervous system (such as a railway accident, the sudden death of a dear relative, or a severe money loss) which haunts him like a spectre day and night, robs him of his rest, and deprives him of his appetite. General exhaustion is favoured by all conditions which give rise to anæmia or faulty nutrition, such as hæmorrhage, prolonged pyrexia, inadequate diet, persistent morbid discharges, or venereal excess; by the retention in the tissues of the products of their activity, which is favoured by working in a foul atmosphere, or by derangement of the excreting functions; by exposure to extremes of temperature; and by a previous condition of excessive slothfulness. General exhaustion may occasionally be suddenly induced by physical causes, such as a severe injury (collapse from shock), or psychical causes, such as fright.

Symptoms.—The symptoms of general exhaustion are:—1. Loss of sleeping power, persistent dreaming, talking in the sleep and somnambulism. The patient may wake in the morning feeling totally unrefreshed. 2. Incapacity for work, and inability to seriously apply the mind to one subject for any length of time. 3. Headache, and a feeling of oppression in the head. 4. Languor and general lassitude. 5. A rapid feeble pulse. 6. An anxious expression of face; and (as stated by Dr. George Johnson) a contracted and sluggish pupil. In addition to these we may get tremor, delirium, hypochondriasis, hysteria, epilepsy, chorea, mania, and general paralysis. Two instances have come within the writer's knowledge of transient hemiplegic symptoms having been induced by excessive application to literary work. The digestion is often deranged, and functional disturbance of the heart is common. Occasionally the urine is altered in quality, and may contain alkaline phosphates or sugar. More rarely it manifests excessive acidity.

2. **Local Exhaustion.**—Local exhaustion is the result of excessive local stimulation, and it is particularly liable to occur as a prominent symptom in patients who are suffering from general exhaustion. The loss of power in the rectum which results from the excessive use of purgatives; the failure of the uterus in cases of protracted labour; and the failure of the voluntary muscles which occurs in those professional ailments of which 'writer's cramp' is the type, may be taken as examples of local exhaustion.

Treatment.—In the treatment of exhaustion the main indications are to lighten the labour, and obtain rest. In cases of general exhaustion it is often advisable to administer narcotics, such as opium, hydrate of chloral, or bromide of potassium, and it will be generally found that, when once refreshing sleep has been established, the more aggravated symptoms will subside. Fresh air and a good diet are most necessary. Stimulants must be used with great caution, for it is clearly not desirable to goad the exhausted organs into further action, although it may be necessary to employ stimulants to give temporary power while the faculty of sleeping is being re-established. All causes of anæmia must be removed. When recovery is established, the patient must be encouraged to relieve the monotony of his life by some pursuit which should be, as it were, the complement of his ordinary occupation. Thus the head-worker should endeavour to amuse himself in his leisure hours by gentle out-door exercise, by music or painting, or by practising some handicraft. *See* Debility, and Fatigue.

G. V. Poore.

EXOMPHALOS (ἔξω, beyond, and ὀμφαλός, the navel).—A term applied to umbilical hernia. *See* Hernia.

EXOPHTHALMIC GOÎTRE (ἔξω, out, and ὀφθαλμός, the eye; and *goître*).—Synon.: Graves' Disease: Basedow's Disease; Fr. *Maladie de Graves, Goître exophthalmique*; Ger. *Glotzaugenkropf, Basedows'che Krankheit.*

Definition.—Enlargement with vascular turgescence of the thyroid gland, accompanied by protrusion of the eyeballs, breathlessness, palpitation, and anæmia.

Ætiology.—This disease is comparatively rare among men. It occurs most frequently in women between the ages of twenty and thirty, but is met with amongst older persons. Patients suffering from it often belong to the so-called nervous diathesis. Its occurrence is often preceded by menstrual disturbance and anæmia. Sometimes no exciting cause can be discovered, but in many cases it comes on after violent nervous excitement.

Symptoms.—Before exophthalmic goître makes its appearance, alterations in temper are frequently observed, the patient becoming irritable and depressed. Functional disturbances of the circulation and heart occur at frequent intervals, the heart palpitating, the face flushing, and a

sensation of fulness being felt in the head, eyes, and throat. The palpitation increases, the eyes become prominent, and a visible swelling appears over the thyroid gland. The eyes are lustrous and projecting, and there is frequently a slight loss of co-ordination between their movements and those of the eyelids, so that when the eyes are quickly cast down the eyelids follow them so slowly that a white ring of sclerotic may be noticed between the iris and the lower margin of the upper eyelid. Usually there is no disturbance of vision. The exophthalmia is most marked during emotional excitement and at the menstrual period, and at these times the patient suffers from an increased feeling of fulness in the eyeballs. Sometimes the projection of the eyeballs is so great that the lids do not perfectly cover them, and inflammation and ulceration may consequently occur. The thyroid is generally unequally enlarged. Its size varies from time to time, increasing, like the protrusion of the eyeballs, with emotion. It is soft and elastic, and pulsates, so that it has sometimes been mistaken for aneurism. The palpitation of the heart is generally noticed before either the exophthalmos or enlargement of the thyroid, and is the first symptom to attract the patient's attention. It is increased by emotion or exertion; and the violent cardiac action frequently produces a prominence of the præcordial region. The cardiac pulsations are rapid and sometimes irregular. The cardiac sounds are loud; and a soft, systolic bellows-murmur is frequently audible at the base, and in the large arteries. The carotids are sometimes, but not always, dilated. The circulation appears to be rapid, the veins filling quickly when emptied, and pulsation being felt even in small arteries. The temperature is frequently high. There is a feeling of general debility. The digestion is sometimes normal, at other times the appetite is diminished or capricious, and diarrhœa may occur. The swelling of the neck may give rise to a feeling of difficulty of breathing; and the voice sometimes becomes altered and hoarse, or may be lost entirely. The course of the disease varies considerably; it may sometimes go on increasing for several months, then it becomes stationary for one or two years, and afterwards begins to decline. The temper improves, the appetite increases, and menstruation frequently is re-established. The palpitation, enlargement of the thyroid, and prominence of the eyes gradually diminish, although they rarely disappear completely. Death may occur from intercurrent disease, from organic cardiac lesions, or from gradual wasting. Danger is also said to arise from pressure on the trachea by the enlarged thyroid.

Pathology.—The protrusion of the eyeballs is due either to dilatation of the vessels in the orbit, or to contraction of the involuntary muscular fibres in the orbital membrane which covers the spheno-maxillary fissure, or possibly to both causes combined. The enlargement of the thyroid is due to dilatation of the vessels of the gland. After the disease has lasted some time, increased formation of tissue in the thyroid gland may occur. Palpitation of the heart is probably due to stimulation of the accelerating cardiac nerves; and this as well as the alteration in the nerves of the orbit and thyroid, has been ascribed to disease of the lower cervical sympathetic ganglia, in which increased connective tissue and diminution of ganglionic cells have been observed.

Diagnosis.—When the three leading symptoms are present, it is impossible to confound exophthalmic goître with any other disease. The enlargement of the thyroid is distinguished in this disease from that of cystic goître by its greater elasticity, by its paroxysmal enlargement, and by its pulsation. The exophthalmos is distinguished from that due to disease of the orbit or cranium by being equal in both eyes, and by the absence of squint. It is distinguished from prominence due to cardiac disease by the lustrous appearance of the eye; from hydrophthalmia by the natural condition of the pupil; and from the prominence which may occur in myopia by the vision being natural, and by the paroxysmal increase of the prominence in exophthalmic goître.

Prognosis.—This must be guarded, the disease not being very amenable to treatment, and very rarely disappearing altogether, although after continuing for some years it may gradually improve.

Treatment.—The treatment of exophthalmic goître chiefly consists in securing fresh air, gentle exercise, the avoidance of the least fatigue or emotional disturbance, and careful diet. Iron is sometimes useful, the milder forms, such as the tartarated iron or citrate of iron and ammonia, being preferable to the more powerful preparations. Quinine, alone or in combination with digitalis—and perhaps with belladonna—often produces good results. Aloes and myrrh may be employed to keep the bowels open. Galvanism to the neck has sometimes been productive of benefit, one pole being placed in the nape of the neck and the other over the sides of the thyroid tumour. When the eyeballs are so prominent as to become liable to inflammation and ulceration, care must be taken, by means of a shade, to protect them from irritation; and if this should prove unavailing, the inflammation must be treated by appropriate remedies. T. Lauder Brunton.

EXOSTOSIS (ἔξω, out of, and ὀστέον, a bone).—A bony outgrowth from any part of the skeleton. *See* Bone, Diseases of.

EXPECTANT ATTENTION.—An important mental state. *See* Mesmerism.

EXPECTORANTS (*ex*, out of, and *pectus*, the chest).—Synon.: Fr. *Expectorants*; Ger. *Auswurfsbefördernde Mittel.*

Definition.—Medicines which facilitate the removal of secretions from the air-passages.

Enumeration. — The leading expectorants are:—(A) Ipecacuanha, Antimony, and Iodide of Potassium; Chlorides of Potassium, Sodium, and Ammonium; and Inhalation of Steam. (B) Squill, Senega, Benzoin, Benzoic Acid, Benzoate of Ammonia; Myrrh, Storax, Balsam of Tolu, Balsam of Peru, Ammoniacum, Galbanum, Assafœtida, Anise, Fennel, Larch Bark, Tar, Copaiba, Vapour of Chlorine, Iodine, Ammonia, Creasote, and Carbolic Acid. (C) Ammonia, Carbonate of Ammonia, Strychnia, Nux Vomica, and Belladonna.

Action.—The mode of action of expectorants

is not well understood, and any explanation of it in the present state of our knowledge can only be regarded as provisional. Expectorants may be divided into two classes:—1. Those which modify the nature of the secretions from the respiratory passages; and, 2. those which modify the respiratory movements by which the secretions are expelled. In considering the mode of action of the first class it must be remembered that the secretions from the respiratory passages depend, like many other secretions, on two factors, the *direct* influence of the *nerves* upon the secreting structures, and the *amount of blood* supplied to them. Each of these two factors may be influenced to a different extent by various drugs. As has already been said, the exact action of each cannot be determined at present, but the first class of expectorants may be subdivided into two divisions which are distinguished in the foregoing enumeration as A and B. The division A rather diminish than increase the activity of the circulation, and are therefore called *sedative* expectorants. The division B somewhat increase the circulation, and are called *stimulating* expectorants. Those comprised under C stimulate the respiratory centre in the medulla oblongata, and increase the respiratory movements.

Uses.—Sedative expectorants (class A) are useful when there is congestion of the respiratory passages, with very scanty, tough expectoration, as in commencing bronchitis. In such circumstances, when dry râles are heard abundantly, with few or no moist râles, the patient often coughs until quite exhausted, bringing up scarcely anything. The administration of sedative expectorants renders the secretion from the respiratory passages more fluid, abundant, and easy to expectorate. When these expectorants do not succeed in ordinary doses, their action may be much assisted by the administration of a purgative, or, still better, by giving either ipecacuanha or tartar emetic in such a large dose as to produce sickness and vomiting. When the distress of the patient is great, the abstraction of a small quantity of blood by cupping or by venesection may give great relief. The inhalation of steam alone is also beneficial, and the air of the patient's chamber should be kept warm and moist. Stimulating expectorants (class B) do more harm than good when administered in the conditions just described, but are beneficial when the acute symptoms have passed off. When this is the case, but the expectoration is tough and somewhat scanty, squill is a useful expectorant; but when the expectoration is abundant, benzoin, balsams, or ammoniacum are preferable. In chronic bronchitis, inhalations of ammonia, chlorine, iodine, creasote, carbolic acid, or pine oil are useful. When the expectoration is fœtid, chlorine, iodine, and carbolic acid inhalations are best. The expectorants which act on the respiratory movements (class C) are useful in cases of debility, as they stimulate the respiratory nervous centre in the medulla oblongata, as well as assist the failing circulation. They may be advantageously combined with stimulating expectorants, such as squill or benzoin, according to the nature of the secretion.

T. Lauder Brunton.

EXPECTORATION (*ex*, out of, and *pectus*, the chest).

Definition.—This word, which strictly means the act of expelling anything from the chest, is usually applied to the matter so expelled, which is also called *sputum* or *phlegm*.

The Act of Expectoration.—The smaller bronchial tubes are kept free from obstruction by the action of ciliated epithelium. The area of the smaller tubes being greater than that of their trunks, the air passes more forcibly through the latter, and so tends, even in natural breathing, to carry speedily away any accumulated secretion. The forcible acts of coughing (*see* Cough) and 'hawking' increase the natural force and fulness of the expiratory effort, and clear the air-passages; the repeated closure of the glottis in coughing increases still further the expulsive effect, by causing the air to escape in sudden jerks. If, in consequence of laryngeal disease, the glottis cannot close, the act of expectoration becomes painful and difficult. Efforts at expectoration are also laboured and futile if, in consequence of emphysema or muscular weakness, the power to take a deep inspiration is lost.

Inability to expectorate is often the immediate cause of death, the 'suffocative catarrh' of the dying being another name for accumulation of phlegm, which the patient is powerless to remove. By teaching the patient 'how to expectorate,' by the administration of a timely stimulant or a quickly acting emetic, or by change of posture, life may in such a case be prolonged. Should the sufferer be allowed to get flurried, the breathing becomes more and more shallow, and deep inspiration and free expectoration are impossible. If, however, the patient can be induced to breathe calmly and deeply, to assume a more easy posture, and to swallow a solution of ammonia with ether, the breathing gradually becomes less shallow and rapid, air enters the deeper parts of the lung, and power is gained to evacuate the accumulated secretion. The act of expectoration is, as a rule, most easy in that posture in which respiration is most free. Sometimes, when the secretion comes mainly from one lung, the aid of gravitation may be called in to empty the obstructed tubes.

Characters and Varieties.—Before auscultation was practised, diagnosis was often based on the character of the expectoration, unwarrantable importance having been attached to the distinction between pus and mucus, on the assumption that pus was diagnostic of phthisis. At the present time we are apt to lose much by falling into the opposite error.

In health, the secretion from the mucous membrane of the air-tubes is a transparent, colourless, slightly glutinous liquid, like thin mucilage; it contains *mucin*, a varying quantity of saline matter, and water.

The saline matter is abundant in the transparent viscid expectoration, deficient in the opaque and less tenacious kind, least in that which is actually purulent.

The ordinary mucous secretion is increased in quantity and viscidity as a result of simple catarrhal inflammation of the bronchial membrane. When bronchitis has existed for some days, a change occurs in the character of the secretion;

instead of being transparent and viscid, it becomes semi-transparent and then opaque, the colour changing to a yellow or greenish hue.

The sputum becomes frothy from the admixture of air; and rusty or prune-juice-coloured if the inflammatory action extends to the ultimate bronchial ramifications, and is of so intense a kind as to allow of oozing from the capillary vessels.

Fibrinous moulds of the bronchial tubes, or chalky masses consisting of inspissated and calcified cheesy matter, are not unfrequently expectorated.

The dark grey or blackish stain often seen in expectoration may be derived from carbon in the atmosphere; or, if it fade on the addition of nitric acid, it may be due to pulmonary pigment formed under slight irritation.

The expectoration may afford important aid in diagnosis, as may be illustrated by the following examples:—If a person with severe chest-complaint coughs frequently and spits only frothy salivary fluid, we may suspect pleurisy. If the fluid is glairy like white of egg, we may suspect bronchitis. If it has a rusty tinge and resembles thick gum-water coloured with blood, we are not likely to err in recording pneumonia. If there is a sudden gush of fœtid pus we may diagnose abscess in the lung or an empyema.

Purulent expectoration may occur in bronchitis as well as in phthisis, but if long-continued, and unaccompanied by distinct rhonchus, it almost always comes from a vomica.

In phthisis the sputum is at first salivary or frothy, the result of irritation; then viscous, indicative of more confirmed affection of the mucous membrane; and subsequently dotted and streaked with blood. Whitish opaque spots, giving a pearly aspect to the expectoration, next appear; these enlarge, become flocculent and ultimately nummular, being inspissated and moulded in a cavity. As the disease advances and involves both lungs, the expectoration is entirely purulent, and shortly before death is often surrounded with a pinkish halo. On placing under the microscope one of the small pearly points described, masses consisting of several air-cells choked with granules, or mere fragments of elastic tissue may occasionally be seen. By the addition of acetic acid the sputa may be rendered transparent, and the elastic tissue is then, if present, more certainly detected; but practically the experienced eye is the best guide in the selection of those small pin-head flocculi of expectoration, in which the microscopic particles of lung-tissue are to be detected.

The microscope may be also helpful by indicating, from the character of the cells, the part of the respiratory tract involved, and the degree of disease existing.

Treatment.—In treatment, much may be gained by study of the expectoration. The cough may often be relieved, and the dyspnœa and other symptoms removed, by effecting an alteration in the nature of the secretion.

If by the frothy character of the sputa congestive disorder is indicated, this may be met by the application of warm poultices, turpentine stupes, or hot flannels externally; and by such means as are calculated to reduce fever and irritability, namely, the administration of salines with antimony or aconite. If the expectoration is too viscid and glutinous for easy removal, lemon-juice, liquor potassæ, soda, or various inhalations give relief, by lessening the tenacity of the secretion; or the change from tenacious and transparent to opaque less adhesive secretion may be hastened by giving iodide of potassium with a few drops of antimonial wine.

When muco-purulent secretion is established and shows no sign of diminution, the use of senega and of the gum-resins is indicated; while benzoin, tolu, and copaiba are also of value. Acetic or tannic acid, given in small and frequently repeated doses, reduces the quantity of secretion.

When the combined glairy and muco-purulent condition of the expectoration and other symptoms give evidence of bronchitis of an established kind, associated with gout or abdominal torpor, a combination of calomel with antimony and guaiacum (as in Plummer's pill) is of the greatest service; but this treatment needs perseverance, discrimination, and watchfulness. The morbid surface may at the same time be medicated by the inhalation of tar, creasote, or oil of juniper, until, with the improvement of the general health, under cod-liver oil and iron, the evil is entirely removed.

E. Symes Thompson.

EXPOSURE, Effects of.—Were the term 'exposure' to be taken in its widest significance, it might fairly assume to include a range of subjects only bounded by the limits of practical medicine. Infection naturally implies exposure to some contagious influence, poisonous gases, or malarious or other unhealthy emanations, bearing in their train a formidable sequence of ill results. Many of the disorders which impair our comfort and shorten our lives may, in short, be traced, in some degree, to exposure of some kind, to an excess of heat or of cold, to a variety of complicated reactions, arising, in whole or in part, from unnatural impressions made on the physiological processes of life by various external agencies. Any study of our subject, however, from this extended point of view, would clearly be out of place here, and effects of extreme elevation and depression of temperature will be fully considered elsewhere, so that exposure, in the sense in which it will be treated here, may be narrowed down to the results which ensue when persons of average constitution-power are submitted, for a longer or shorter time, to the influence of ordinary cold, or wet, or damp. Now, it is an old saying, that if five or six people, of either sex, suffer shipwreck, or are wet through, or excessively chilled by moist cold, each will probably suffer in some different way. One may altogether escape, and not experience inconvenience of any kind; a second may 'catch'—as the popular expression puts it—a sore throat, or a 'bad cold;' whilst a third may be seized with pneumonia, and a fourth with rheumatic fever.

Individual constitution or peculiarity of system partly explains these differences, and the familiar term of a 'weak point somewhere,' if not conveying much impression of scientific accuracy, is right so far in showing that the internal congestion caused by sudden contraction of cutaneous arterioles is most naturally directed to that organ

whose vessels have been weakened by previous inflammation. If the patient, therefore, have previously suffered from tonsillitis, or bronchial congestion, or rheumatism, he will be predisposed to a recurrence of the same affection on a renewal of the exciting cause. If, again, from sedentary occupation and over-indulgence in nitrogenous food, his blood be overcharged with the products of retrograde metamorphosis or of imperfect assimilation, it only needs the closure of the eliminatory agency of the skin, to provoke the irritation of internal organs, and to induce an attack of gout or rheumatism, or an acute inflammation of kidneys or liver. The effects of exposure, even in this limited sense, are thus tolerably various both in extent and in degree, and may be studied on a large scale during our greater campaigns, and in lesser degree during the ordinary autumn manœuvres, when the weather happens to be unfavourable. Here, however, everything injurious is minimised by the healthy condition of the men, their good clothing and food, and the enforced regularity of habits, which prevent, in great measure, one of the most fertile causes of damage from exposure. It is now well known that nothing tends so seriously to impair the power of bearing either extreme of temperature as the excessive indulgence in strong drink; so that in treating anyone who has been exposed to the influence of cold and wet, we must not forget to take also into account the probable combination of the depressing effects of alcohol on the nervous system. Illustrations of this must be familiar to all, and we must all have met with numerous cases in which tramps or other persons with weakened bodily vigour have been brought into our hospitals, suffering from the effects of exposure in various degree.

Treatment.—In seeking to remedy the effects just described, it will be found that some of the cases will recover under the influence of warmth and good food, and the generally invigorating effects of careful nursing, whilst others, on the other hand, may succumb to the rapidly destructive tendencies of acute disease, or to the slower pathological processes of chronic lung or kidney degeneration. In the treatment, therefore, of such cases, we must not only add to the genial influences of home or hospital care such special drugs as the varied development of symptoms may require, but we must carefully take into account the occurrence of various serious or profoundly disorganising complicating causes. Thus if our patient has been found in an insensible state, we may reasonably suspect apoplexy or alcoholic or narcotic poisoning, and act accordingly. And only when all such suspicion is finally removed can we rest on our oars, and confine our attention to the immediate effects which follow exposure of the kind indicated above. Warmth, rest, and the regulated use of stimulants and food will now be indicated, and must be employed, with all the precautions suggested by the ordinary principles of therapeutics, and common sense.

Robert Farquharson.

EXSANGUINE (*ex*, without, and *sanguis*, blood).—Deprived more or less of blood—bloodless. Sometimes used synonymously with anæmic. *See* Anæmia.

EXTRA-UTERINE PREGNANCY.—*See* Pregnancy, Disorders of.

EXTRAVASATION (*extra*, without, and *vasa*, vessels).—Synon.: Fr. *Extravasation*; Ger. *Extravasat.*

Definition.—Extravasation is the escape of any of the fluids of the body, normal or abnormal, from the vessel, cavity, or canal that naturally contains it, and its diffusion into the surrounding tissues. The result of the effusion is also called an extravasation. Extravasation is the effect of rupture or perforation of the walls of a hollow organ, and may therefore be due to injury, to weakness of the parietal structures, to morbid conditions of the blood, or to increase of internal pressure. *See* Perforations and Ruptures.

The fluids most frequently found extravasated are blood, urine, bile, the contents of the alimentary canal, and certain constituents of morbid growths and fluid collections. The present observations will apply chiefly to extravasation of blood.

Extravasation of Blood.—The blood is peculiarly liable to extravasation, the vessels being universally distributed, much exposed to injury, and subject also to a constant pressure from within, which may be suddenly and greatly increased. Any portion of the circulatory system may give way: either the heart, as in fatty degeneration; the arteries, as in aneurism; the capillaries, as in pulmonary hæmorrhage; and the veins, as in the subcutaneous rupture of a varix.

When the effusion takes place into one of the serous sacs, it forms a collection of blood, variously named *hæmothorax*, *hæmatocele*, &c. If the subcutaneous, submucous, or other connective tissue, or the substance of an organ be invaded, the effused blood finds its way between the elementary textures, separating and compressing them; and there are formed what are described simply as *extravasations* of blood, or more definitely, according to their extent, as *parenchymatous* or *interstitial hæmorrhages* or *apoplexies*, *suffusions*, *ecchymoses*, *petechiæ*, or *vibices*. The seat of effusion appears of the colour of blood or its derivatives; but if much below the surface, the extravasation may not be visible for some days, after which time it appears of a bluish, greenish, or yellowish hue. The extravasated blood generally coagulates; the fibrin and albuminous substances are absorbed; and the products of decomposition of hæmoglobin, which are much more slowly removed, give rise to the discolourations. Much less frequently the effused blood becomes encapsuled, forming a *hæmatoma* or *blood-cyst*. In other cases it decomposes, and sets up gangrene around, or inflammation of the nature of severe cellulitis, which may end in ulceration of the surface. When the blood is forced between the coats of the perforated vessel, there is formed what is called a *dissecting aneurism*. If the extravasated blood escape from the surface of the skin or mucous membranes, one form of *hæmorrhage* or a *bloody flux* is the result.

The *symptoms* of extravasation of blood are so various that they cannot be stated in general terms. If extensive and affecting vital parts, the effusion may be attended by shock, syncope, or death; and it may lead to constitutional disturbance in many forms. Local pain is not common unless the extravasation be severe. The pressure of the effused blood upon the vessels, nerves, and muscles of the part, for example in a limb, may produce paralysis, disturbances of sensibility, œdema, loss of temperature, and even gangrene. As a rule, however, extravasations of blood are very limited in size, give rise of themselves to no serious symptoms, and readily disappear by absorption.

J. Mitchell Bruce.

EXTROVERSION (*extra*, outwards, and *verto*, I turn).—The eversion or turning inside-out of a part, as the eyelids or bladder. In the bladder, extroversion is associated with that condition, usually congenital, in which the anterior wall of this organ and of the abdomen are deficient, and its posterior wall projects through the opening thus formed.

EXUDATION (*exudo*, I sweat).—The process by which certain of the elements of the blood pass through the walls of the blood-vessels into the surrounding tissues, as in inflammation. It also indicates the products of the process when they are of a fibrinous or coagulable character. *See* Inflammation.

EXUDATION-CORPUSCLES.—The cells found in inflammatory products, whatever may be their origin. *See* Inflammation.

EYE, and its Appendages, Diseases of.—It will be most convenient to arrange the consideration of the diseases of the eye according to the anatomical order of the structures affected, namely:—I. Diseases of the Conjunctiva; II. Diseases of the Cornea; III. Diseases of the Sclerotic; IV. Diseases of the Iris; V. Diseases of the Crystalline Lens; VI. Glaucoma; VII. Diseases of the Optic Nerve and Retina; VIII. Diseases of the Choroid; IX. Diseases of the Vitreous Body; and, X. Diseases of the Eyelids.[1]

I. Diseases of the Conjunctiva.

1. *Inflammation.* Synon.: Conjunctivitis.—The conjunctiva is exceedingly liable to inflammation, and its inflammations are commonly arranged in groups, which are sufficiently distinct in their typical examples, but are not separated by any definite boundary lines.

In their earlier stages inflammations of the conjunctiva possess many characters in common. They are all attended by the four signs of inflammation—heat, redness, swelling, and pain; although both the heat and the swelling are usually kept within limits by the discharge, which is often free, sometimes profuse, at first mucous, afterwards muco-purulent or truly purulent in character. If, however, the exudation be of a firmer consistence than usual, it not only produces a superficial discharge, but distends the meshes of the sub-mucous tissue, elevates the conjunctiva from the sclerotic, and causes it to overlap the corneal margin as a swollen ridge; a condition which is known as *chemosis*. The redness depends, of course, on the degree of the congestion, which may or may not be sufficient to obliterate the intervascular meshes, and to produce an uniform colour; and the pain is not severe, except in cases of very dense sub-conjunctival swelling. From other forms of inflammation, that of the conjunctiva is distinguished by certain negative characters. Unless as a result of secondary changes, or as a mechanical effect of the presence of a film of turbid secretion, the transparency of the cornea is not affected, and the acuteness of vision is not impaired. The congestion is limited to the conjunctiva, and the distended vessels can be emptied for a moment by pressure through the lower lid, so as to reveal a glimpse of the white sclerotic underneath.

In mild cases conjunctivitis is an unimportant affection, but in its more severe forms it is attended by two distinct sources of danger. During its acute stage it may produce partial or complete necrosis of the cornea, leading to great impairment of sight and not seldom to blindness; and when chronic it often occasions great hypertrophy of the papillæ of the portion of the membrane which lines the lids. These papillæ may even become converted into shaggy or warty excrescences, which mechanically irritate the corneal surface, and cause the development of vessels beneath its epithelium. In time the papillæ dwindle, and the effusion round about them contracts, thus rendering the tarsal cartilage (especially that of the upper lids) incurved, and bringing the cilia to rest upon the surface of the eyeball. Great distress and permanent impairment of vision may be thus occasioned; and the progress of the contraction may be so slow as to deprive it of any manifest connection with the inflammation in which it had its origin.

The chief varieties of conjunctivitis are:—(*a*) *infantile*; (*b*) *simple* or *catarrhal*; (*c*) *contagious*; and (*d*) *diphtheritic*.

(*a*) *Infantile Conjunctivitis.* Synon.: *Ophthalmia neonatorum.*

Ætiology and Symptoms.—Infantile conjunctivitis is probably due, in most cases, to direct inoculation with vaginal secretion. It usually commences on or about the third day after birth, and passes rapidly into the purulent form. It is attended by considerable puffy swelling of the lids, and by profuse thick discharge, which soon dries upon the tarsal margins, and often causes them to cohere. If neglected or improperly treated, the disease often leads to sloughing of the cornea; but it may always be cured if it is seen while the cornea is still bright.

Treatment.—The treatment required is to wash away the discharge carefully and frequently; to apply an astringent lotion (the best is a solution of 2 grains of nitrate of silver to an ounce of distilled water) to the conjunctival surface every four hours, or less frequently when improvement is established; and to anoint the edges of the lids with simple ointment to prevent their agglutination. In cases of inherited syphilis mercurial inunction should be prescribed; the infant's food must be carefully regulated if it is brought up by hand, and if it is very feeble it may

[1] *See* also Vision, Disorders of; Ophthalmoscope; and Ophthalmoscope in Medicine.

take a little cod-liver oil, combined in an emulsion with two-minim doses of liquor cinchonæ. Where the mother's milk fails, it is often desirable to obtain a wet-nurse; but the local treatment is that which is chiefly important, and upon which, in most cases, entire reliance may be placed.

(*b*) *Simple* or *Catarrhal Conjunctivitis.*

Ætiology and Symptoms.—This form of conjunctivitis is usually due to exposure to cold or to some chemical or mechanical irritant. Its most distinctive character is that the discharge is chiefly mucous, and has not much tendency to become purulent.

Treatment.—In every case the surface of the eyeball, and the lining membrane of the lids, should be carefully examined for any foreign body which may be the cause of the trouble; and if such should be found and removed, there will seldom be need for further treatment. If there is no foreign body, the 2-grain solution of nitrate of silver may be placed within the conjunctival sac, by means of a quill or dropping bottle, every two or three hours, and speedy recovery will usually be the result. During the treatment the eyes should have functional rest, and should be sheltered from external cold, from dust, or from glare.

(*c*) *Contagious Conjunctivitis.* Synon:—Purulent Ophthalmia.

In this form the discharge rapidly assumes a purulent character. This may happen when the simple form is aggravated by the state of the patient or by accidental circumstances; or when the disease is produced by inoculation with the discharge from a similar case, or with contagious pus from the urethral or vaginal mucous membrane. The state of the patient which is most likely to promote the development of the contagious form is that in which the conjunctiva is beset with the granular semi-transparent bodies, formed by aggregations of lymph-corpuscles, which are known as 'sago-grains' or follicular granulations. These bodies are commonly present in the eyelids of persons (especially of young persons) who are crowded together under insanitary conditions of living, as in barracks, camps, or badly regulated schools; and their presence renders the conjunctivitis of simple irritation prone to assume a purulent character. It is impossible to say how soon the discharge of conjunctivitis becomes contagious, or capable of reproducing the disease in others; but its activity in this respect seems to bear some proportion to the intensity of the inflammation which produces it; and the activity of gonorrhœal pus is probably greater than that of any conjunctival product. In the more intense forms of purulent ophthalmia there is great swelling of the lids and of the ocular conjunctiva, early chemosis, and a tendency to speedy sloughing of the cornea; while the milder forms pass into the catarrhal by imperceptible gradations.

Treatment.—In the space available for the purpose in these pages, the treatment of contagious conjunctivitis cannot be described in detail. It mainly rests upon the action of local astringents, graduated in strength according to the severity and the stage of the disease. In the worst cases the eyelids must be everted, and the whole of the palpebral conjunctiva carefully touched with a stick composed of one part of nitrate of silver fused with four parts of nitrate of potash. The caustic should be neutralised by a drop or two of a solution of common salt, applied by means of a camel's-hair pencil, before the lid is suffered to return into contact with the cornea; and the cauterization must be done carefully and with a light hand, so that the resulting eschar may include only the epithelium; for if the basement membrane is destroyed, there will be danger of subsequent adhesions between the eyelids and eyeball. The cauterization should be repeated about every eight hours, or as soon as the eschar falls, and in the intervals, if the patient is awake, the conjunctiva should be gently syringed every hour with a weak alum lotion at a comfortable temperature. The tension of chemosis may be diminished by radial incisions, outwards from the corneal margin, carried nearly down to the sclerotic; the strength must be supported by good diet and tonics; and the nervous system calmed by anodynes. In milder cases the principle of treatment must be the same, but the local applications less severe; and in chronic cases the local applications must be continued, after apparent recovery, so long as any residual thickening, capable of undergoing eventual contraction, can be found lurking in the palpebral folds.

(*d*) *Diphtheritic Conjunctivitis.* This malady has chiefly been made known to us by the observations of German writers, and very few authentic instances, if any, have been recorded in this country. But it has from time to time prevailed extensively in Berlin, and might at any time make its appearance amongst ourselves.

Symptoms. — Diphtheritic conjunctivitis is attended with great heat and pain, and with very hard, brawny swelling of the eyelids; but its most characteristic symptom is the infiltration of the sub-conjunctival tissue by the so-called diphtheritic effusion, which does not form a pellicle upon the surface, but distends and fills the cavities of the areolar tissue. The result is to produce a pale, firm swelling of the conjunctiva, and a great tendency to rapid sloughing of the cornea. The subjects of the malady are mostly feeble and badly-fed children, and the cases are described as being almost hopeless unless early admitted into hospital.

Treatment.—The indications for treatment are chiefly to support the strength by suitable regimen; to apply ice or bags of freezing mixture to the lids during the hot stage; and to change the cold applications for hot ones as soon as the period of resolution, absorption, or repair can be said to have commenced. In the meantime iron and quinine should generally be administered internally.

2. *Episcleritis.*—An affection which is apparently but not really conjunctival, being situated in the tissue between the conjunctiva and the sclerotic, is that which has received the name of *episcleritis*, and which was formerly described as 'sclerotitis with inflammation of the insertion of a rectus muscle.'

Symptoms.—It appears as an elevated patch of congestion, gradually passing into the natural level and appearance of the parts, and seated on

the ocular surface near the corneal margin, most frequently on the temporal side. On close examination, the congestion, with the exception of a few dilated vessels, is seen to be sub-conjunctival, and to be attendant upon a circumscribed but not sharply defined swelling or thickening, which is adherent to the sclerotic, and which presents, in the interstices between the blood-vessels, an appearance as if it consisted of some new deposit, generally of a yellowish tint, external to that membrane. The swelling is indolent, chronic, and in itself generally painless, although it is sometimes accompanied by severe neuralgia. The subjects are most frequently women, especially such as are anæmic or otherwise out of condition. Episcleritis may last for months with little change, and it seems to be harmless as regards the other structures of the eye.

Treatment.—The writer has found episcleritis resist all medication except the internal administration of mercury, to which it will often yield in the course of a short time. The best preparation is the perchloride, in doses not exceeding $\frac{1}{16}$ of a grain, which may usually be combined with five or ten minims of the tincture of perchloride of iron. At the same time it is often desirable to sprinkle a little dry calomel over the swelling once in twenty-four hours; but this application is less important than the internal treatment, and should not be continued unless it is soon and distinctly beneficial.

3. *Hæmorrhage.*—Effusion of blood beneath the conjunctiva may occur spontaneously, but is generally traceable either to a direct injury or to violent exertion. Thus it may follow slight blows upon the eyeball, as from a twig or switch; or may be produced by a paroxysm of coughing, especially in pertussis; or may occur from the rupture of a vessel during parturition, or upon lifting a heavy weight. It is always unsightly. When traceable to any of the foregoing causes, the hæmorrhage is usually a matter of no moment; but when it happens during the night in young people, it should lead to a suspicion of nocturnal epilepsy, which has often been first discovered by its means. Moreover, in advanced life, more especially when occurring without adequate cause, it may point to arterial brittleness, of a kind which may indicate danger of a like hæmorrhage within the cranium. On these grounds it is a symptom which always calls for full inquiry into its causes, and which may sometimes afford useful warning of impending danger.

Treatment.—Absorption may be promoted by covering the closed lids by a compress moistened with a lotion of spirit and water, or of tincture of arnica and water if an appearance of more decided medication is desired.

II. Diseases of the Cornea.—Diseases of the cornea, as already indicated, are often secondary to those of the conjunctiva, and may arise in their course as complications.

1. *Ulceration.*

Ætiology and Symptoms.—To the present group belong all the corneal ulcerations of purulent ophthalmia, whether infantile or of a later period of life; and also the forms of corneal ulcer which are produced by the friction of eyelids rendered rough by inflammation, or by the friction of eyelashes which have been turned inwards by distortion of the tarsal cartilage. When ulceration of the cornea occurs in the course of conjunctivitis, it at once invests the latter malady with a highly formidable character. The corneal tissue, once destroyed by ulceration, is not reproduced in its original transparency, but only as a more or less dense and opaque white cicatrix, which is at the same time disfiguring to the appearance and an impediment to vision. If the ulcer should perforate, the iris almost necessarily becomes adherent to the cicatrix; and if the loss of substance is of large superficial extent, the resulting cicatrix is often thin and feeble, so that it is rendered prominent by the pressure within the eye, producing the condition which has been called 'staphyloma,' and gradually elevating and distorting the surrounding portions of clear cornea. The first effect of the healing of a corneal ulcer is generally to flatten the natural curvature of the membrane; but the secondary effect, if the cicatrix becomes prominent, may be to modify this curvature in various ways. Hence it follows, even when a cicatrix of the cornea is surrounded by a still transparent annulus, behind which an artificial pupil may easily be made by the excision of a portion of the iris, that the surgeon cannot predict with any certainty the quality of the vision which will be obtained, unless he is able, before operating, to determine the state of the corneal curvature. This is only possible when the margin of the pupil is so far free that it can be dilated with atropine sufficiently to render the fundus of the eye visible with the ophthalmoscope. When this can be done, any portion of cornea through which a clear view of the retinal vessels can be obtained by the surgeon will also afford clear vision of external objects to the patient; but, if no such place can be discovered, a very cautious opinion should be given with regard to the degree of benefit which may be hoped for from an operation.

Treatment.—The extreme importance of the cornea to the visual function renders it necessary that its integrity should be guarded with the greatest possible care. In any case of conjunctivitis, of even moderate severity, the cornea should be watched from day to day, and any appearance of turbidity about its central portion, or of elevation or irregularity of the epithelium at its margin, should lead to a reconsideration of the treatment which is being pursued. The former of these conditions is the ordinary precursor of sloughing ulcer or necrosis; the latter, of the extension to the cornea of an inflammatory process.

The general principles which govern the treatment of sloughing ulcer are, that the eye should be kept under the influence of eserine, which has a marked effect in checking the extension of ulceration by arresting the migration of white corpuscles; that any astringents which may be applied to the conjunctiva should be prevented from coming into contact with the cornea; that strength should be supported, pain relieved, and local nutrition stimulated by hot applications. When the ulcer continues to spread, its progress may often be arrested by diminishing the tension of the globe by the evacuation of the aqueous humour; and this may be accomplished either

by repeated paracentesis at the corneal margin, or by Saemisch's method of cutting through the base of the ulcer, and reopening the incision daily until a process of repair is well established, or by the performance of iridectomy. Of these three courses, the last-named is the most generally applicable. It not only produces the immediate effect which is desired, but it has also the incidental advantage of establishing an artificial pupil at the side of the cicatrix.

The application of eserine is best effected by using a solution of the neutral sulphate, of the strength of four grains to the ounce of distilled water; and a drop of this solution may be placed within the conjunctival sac twice or thrice daily.

The sloughing ulcers of the cornea which arise from causes other than conjunctivitis, as injury, or failure of nutrition, must be treated upon the same principles which have already been laid down. There are, however, inflammatory ulcers which require the use of local applications of a stimulating kind, among which dry calomel and other mercurials hold a prominent place. Such ulcers have usually a leash of vessels running from the corneal margin, and are often obstinately recurrent; whence they are known as 'recurrent vascular ulcers.' They are usually connected with some manifest systemic derangement, and are often attended by photophobia. They leave scars upon the cornea, of a size and opacity proportionate to their extent and depth; and on this account it is desirable, whatever constitutional treatment may be required, to heal the ulcers themselves as speedily as possible, by the aid of local applications. In the early stages of the ulceration, eserine should be used; but afterwards either dry calomel or an ointment containing from ten to thirty grains to the ounce of the precipitated yellow oxide of mercury, which may be thrown down by any alkali from a solution of the perchloride. This ointment was introduced into practice by Dr. Pagenstecher, of Wiesbaden, and is often called by his name. In very obstinate cases Mr. Critchett recommends setons in the temporal regions; but the operation of iridectomy will often afford a still more efficacious remedy. Where there is much photophobia, the use of eserine is especially indicated, because, in addition to its action above mentioned, it produces contraction of the pupil, and thus gives comfort by lessening the quantity of light which is admitted into the eye. If the photophobia is very severe or intractable, it is often beneficial to divide the orbicularis muscle freely at the outer canthus, so as to diminish the pressure which is caused by its spasmodic contraction, and which sometimes seems to be a chief cause of the irritability. After such an incision, a cold compress should be applied, and the patient kept in the dark for a few hours, after which there will often be a marked alleviation of this distressing symptom, and a greatly increased general amenability to treatment.

2. *Inflammation.* Synon.: Keratitis.—Inflammation of the cornea presents three distinct types, the *suppurative*, the *vascular* and the *interstitial*.

(*a*) *Suppurative keratitis.* Suppurative inflammation or abscess of the cornea seems to be essentially a phlegmon or boil of the corneal tissue, a portion of which dies, and is cast off in the form of a slough.

Symptoms.—The abscess commences as a very tender grey spot in the cornea, surrounded by a zone of turbidity, and accompanied by a good deal of ciliary neuralgia, as well as by a variable degree of lachrymation, conjunctival congestion, and intolerance of light. Under the influence of atropine, hot fomentations, and such constitutional treatment as the state of the patient may demand, the threatened suppuration is sometimes averted, and the turbidity clears away. More commonly pus is formed, and makes its way either externally, leaving an ordinary ulcer; or internally, producing the condition called *hypopyon*, in which there is pus in the anterior chamber. Sometimes it separates the corneal laminæ to a considerable extent before perforating them, and is then called *onyx*, from a fanciful resemblance to the lunula at the base of a finger-nail.

Treatment.—When suppuration is no longer doubtful, the best practice is to evacuate the abscess by a puncture from within, by thrusting a cutting needle into the anterior chamber near the corneal margin, and then causing its point to penetrate the cavity of the abscess. The mingled pus and aqueous humour will escape as the needle is withdrawn, and its wound of entrance may be reopened once or twice daily by a probe, so as to insure the complete removal of all inflammatory products, until the healing process has made some way. If the abscess has burst internally before the case is seen, atropine should be applied without delay. If the pupil dilates fully, and the quantity of pus in the anterior chamber is but small, the case may be left to the *vis medicatrix naturæ*, care being taken to enforce rest and to exclude noxious influences. If the quantity of pus is large, it should be let out by paracentesis; and if the atropine reveals adhesions of the iris, iredectomy should at once be performed. An abscess which has burst externally leaves simply an ulcer, generally with a disposition to heal readily, and requiring only such treatment as has already been described.

(*b*) *Vascular Keratitis.* Vascular inflammation of the cornea is often a very severe and protracted malady, which usually leaves behind permanent opacity and impairment of sight.

Symptoms.—It commences, in typical cases, by the formation of two crescent-shaped patches of vascularity, one at the upper and the other at the lower portion of the cornea. The patches are formed by the development on the corneal surface of innumerable fine blood-vessels, so closely packed together that the interstices which separate them are scarcely discernible by the naked eye, and the affected parts present an uniform aspect of vivid redness. The crescents are somewhat elevated above the general corneal surface, and each crescent is bordered, along its concave or advancing edge, by a line of precursory epithelial turbidity. At the same time that the crescents increase in size, the borders of precursory turbidity are pushed before them; until at first these, and afterwards the crescents them-

selves, may meet and coalesce on the horizontal diameter of the cornea, so that its whole surface may become uniformly red. When this stage is reached, vision is almost abolished, but there may still be much intolerance of light. The corneal tissue is softened, and its margin is surrounded by a zone of sclerotic vascularity, which is visible through the congestion of the conjunctiva. As the inflammation subsides the vascular crescents slowly recede from the centre of the cornea towards its circumference, and finally disappear, leaving behind them a dense opacity of an extremely obstinate character. A severe case of vascular keratitis generally affects both eyes, and threatens a long period of actual blindness, followed by a long period of very imperfect vision. The worst examples of the malady are those which have been treated at the outset by astringent or irritating applications; and, even in the slighter forms, the malady is nearly always obstinate and protracted. As long, however, as the march of the vascular crescents, or their precursory turbidity, has not encroached upon the portion of cornea in front of the pupil, so long vision is not seriously jeopardised.

Treatment.—The great object of treatment is to arrest the new vascular development at a comparatively early stage; and for this purpose it is necessary to have recourse to eserine and sedatives locally, and to such constitutional treatment as the general condition may require. A solution of two grains of the neutral sulphate of eserine to an ounce of distilled water should be dropped into the eye twice daily, and the closed lids should be frequently fomented with hot poppy decoction, or with cold solution of extract of opium in water, according as one or the other temperature is the more agreeable to the feelings of the patient. Apart from any special indication, the medicines most generally useful are those which appear to influence local nutrition through the central nervous system, such as the iodide and bromide of potassium, and the sulphate of quinine. These, if they are likely to exert a beneficial effect, generally do so speedily; and if the malady should be rapidly extending, it is always prudent to reconsider the prescription without much loss of time. In severe cases, especially when the lids are somewhat tumid and there is much photophobia, a leech may often be applied with advantage, usually over the temporal muscle, close to the outer margin of the orbit, or a little blood may be taken more rapidly, by means of Heurteloup's artificial leech; and when, notwithstanding treatment, the malady pursues its course unchecked, a large iridectomy should be made without undue delay. The operation not only tends to arrest the vascular formation, but it also leaves a lateral pupil through which good sight may often be obtained long before the transparency of the central parts of the cornea is restored.

Development of vessels upon the cornea.—It is necessary carefully to distinguish vascular keratitis, properly so called, from that development of vessels upon the cornea which may occur in connection with the cicatrisation of ulcers, or in consequence of the friction of lids left granular by conjunctivitis. In both these forms the new vessels are arborescent and irregular in their distribution, instead of being closely packed together: and they are not attended by the pink zone of circum-corneal congestion, which is never absent in true corneal inflammation.

The vessels which attend the formation of cicatrices generally dwindle in course of time: while those produced by granular lids, and which, when they are very abundant and closely set, constitute the condition called *pannus*, will often disappear without direct treatment if the state of the lids themselves can be favourably modified by the application of astringents. In many cases the vascular network of pannus will be comparatively absent from the lower third of the cornea, so that sight may be much improved by an artificial pupil made in a downward direction. When pannus covers the whole cornea with a close vascular network, so that sight is almost destroyed, and when it resists milder treatment, it may sometimes be cured by inoculation with the discharge of infantile purulent ophthalmia. The pus is inserted between the lids, and the artificial malady suffered to run its course unchecked, except by cleanliness and frequent bathing. When the discharge has ceased, the cornea will often clear in a surprising manner, and its abnormally vascular state protects it, to a very great degree, against the risk of sloughing. Still, this risk is by no means absent, and the treatment by inoculation should be regarded only as a last resource.

(*c*) *Interstitial Keratitis.* This is a chronic malady which is seen chiefly, or perhaps exclusively, in the subjects of inherited syphilis, who possess the peculiar teeth and *facies* which Mr. Hutchinson has shown to be characteristic of their inheritance. The disease was long described as a variety of 'strumous ophthalmia;' and, although the late Sir William Wilde pointed out how frequently it was associated with deafness, and also laid stress upon the value of perchloride of mercury in its treatment, its syphilitic character seems to have been first suspected by Mr. Hutchinson, who, having once obtained the clue, followed it with characteristic diligence until he arrived at a conclusive demonstration of the accuracy of his suspicion.

Symptoms.—Interstitial keratitis commences as a slight cloudiness of the central portion of the cornea, with some roughening or irregularity of the epithelium. It extends from the centre towards the margin, and is liable to be attended, in different cases and at different stages of its course, by variable degrees of ciliary and corneal congestion, and intolerance of light. If neglected, or if treated by irritants, it is liable to assume the characters of vascular keratitis, and also to extend to the iris, in such instances often doing irreparable mischief. It is most common during childhood, but its appearance may be delayed until adolescence, or even until adult age. It attacks both eyes, one commonly somewhat later than the other, and its course is often protracted over several months. When severe, it leaves some residual cloudiness of the cornea, and, even when mild, it is doubtful whether the cornea ever entirely regains the transparency of health. Still, when a case is seen and judiciously treated early, the prognosis may generally be a favourable one.

TREATMENT.—The treatment consists primarily in the avoidance of all irritants; the use of eserine and local sedatives; and the administration of perchloride of mercury, or of iodide of potassium, with or without iron or cod-liver oil. When they are not contra-indicated by any special circumstances, the perchloride of mercury and the oil are the remedies on which the greatest reliance may be placed. The earliest indications of photophobia, showing, as they do, that light is acting as an irritant, should be met by confinement to an almost darkened room, and by frequent bathing of the closed lids with cold water; but in fine weather daily exercise should be taken in the open air, the eyes being covered for the time with a black silk bandage and compresses of carded wool, so as to exclude light entirely. As soon as photophobia subsides, these precautions may be left aside—the eserine and mercury being still continued, at least until the acute stage of the malady has entirely passed away. After this the absorption of residual opacity may be promoted by the application, once daily, of a morsel of an ointment containing a small quantity (about ten grains to an ounce) of the precipitated yellow oxide of mercury.

In cases which have been neglected, or aggravated by irritants in their early stages, and in which the phenomena of ordinary vascular keratitis become grafted upon the interstitial, it is generally desirable to perform iridectomy with as little delay as possible.

3. *Arcus Senilis.*—The condition thus named (although the adjective is not always appropriate) is fully described elsewhere. (*See* ARCUS SENILIS.) It may be distinguished from the peripheral zones of opacity, which are sometimes left after the subsidence of certain forms of keratitis, by the circumstance that arcus never extends quite to the margin of the cornea, but is always surrounded by an annulus of transparent tissue.

Besides the foregoing, there are a few other forms of corneal disease, of comparatively rare occurrence, which it would be beyond the limits of these pages to describe, but which must be treated on the same general principles; and there is also the malformation known as 'conical cornea,' which falls wholly within the domain of surgery.

III. **Diseases of the Sclerotic.**—Diseases of the sclerotic, which were once regarded as a numerous and important group, have been reduced by recent investigations to comparatively insignificant proportions.

Inflammation.—SYNON.:— Sclerotitis. — Excepting in a narrow annulus immediately around the cornea, the sclerotic is almost extra-vascular; and any real inflammation of its structure is almost confined to this particular region, where it seldom occurs excepting as a complication, or as a part of some of the more severe forms of iritis or keratitis, especially when either of these affections extends to the ciliary body. In such cases we often see the sclerotic undergo inflammatory softening, as a result of which the ciliary region may be much altered in shape, yielding to the distension of the eyeball and to the traction of the recti muscles, and becoming distinctly elongated. Occasionally the sclerotic may be so much softened and thinned as to bulge into irregular prominences around the cornea, generally under the upper lid; and this condition is described as *sclerotic staphyloma.*

TREATMENT.—The inflammations thus arising call for no other treatment than that which is demanded by the more important inflammations of the cornea, the iris or the ciliary body, with which they are associated; except that any evidence of yielding of the sclerotic would be a reason in itself for the performance of iridectomy, in order to preserve the shape of the eyeball by diminishing its tension. It was once believed that the sclerotic, in its character of a fibrous membrane, was especially prone to gouty or rheumatic inflammation; and it is perhaps true, though certainly not proven, that the tendency of iritis or of keratitis to spread to the anterior sclerotic zone is more marked in persons of gouty or rheumatic diathesis than in others. The possibility is at any rate sufficient to require, in all these cases, an investigation of the tendency to lithic acid formation, and the use of appropriate remedies when this tendency is discovered. But a large proportion of the examples of supposed gouty or rheumatic ophthalmia are nothing more than cases of the sub-acute or remittent form of glaucoma; and the pain associated with them is not really rheumatic but simply tensive. Vision has been irretrievably lost, in hundreds of instances, because a belief in the rheumatic character of these affections has interfered with the timely performance of iridectomy; and the proposal to adopt the epithet 'rheumatic,' in any form of eye-disease, is one which should be scrutinised very closely before it is accepted as a guide to practice.

IV. **Diseases of the Iris.**—In so far as they come into the province of the physician, diseases of the iris are not numerous, and are almost limited to the varieties of inflammation of that membrane.

1. *Inflammation.* SYNON.: Iritis.—Iritis may be classified according to its actual or supposed causes, as rheumatic or syphilitic; or according to the nature of the morbid process, as *plastic*, *serous*, or *suppurative.* The former classification must often rest upon very slender grounds, and the latter has the great advantage of expressing facts rather than inferences.

(*a*) *Plastic Iritis.* SYMPTOMS.—In plastic iritis the first symptom is usually some loss of the natural lustre of the surface of the iris, and of the clear definition of its fibres, together with some damping or alteration of its colour. These changes are probably always due to turbidity of the aqueous humour, and they may be imitated more or less closely by turbidity of the cornea, and especially by disturbance of its epithelium. In iritis, however, they are associated with a diminished range and quickness of pupillary variation under variations of light; and, in a short time, with the effusion of plastic lymph, by which the margin of the pupil becomes tied down, here and there, to the surface of the anterior capsule of the crystalline lens. At the same time there is usually some congestion of the conjunctiva, and of the zone of fine vessels immediately around the cornea in the sclerotic. There is frequently more or less

pain, especially towards night, but this is a very uncertain symptom. In severe cases, and especially in such as are clearly syphilitic in their character, the quantity of effused lymph may be very considerable, so as quite to cover the pupil, while in mild cases it is only sufficient to fasten down the margin here and there. Iritis is sometimes a very insidious and seemingly slight affection, the real gravity and importance of which may be wholly overlooked by the patient.

Treatment.—The first principle of treatment is to prevent the formation of adhesions, or to break them if they have been formed; and for this purpose our main reliance must be placed upon the instillation of atropine. The anatomical structure of the eye is such that a moderately contracted pupil is in contact with the lens-surface, while a fully dilated pupil is separated from it by a film of aqueous humour. Hence, as long as the pupil is contracted, any lymph which is effused tends to the immediate formation of adhesions; while, as soon as the pupil is dilated, the lymph diffuses itself harmlessly in the surrounding fluid, and no adhesions are produced. In ordinary circumstances, and in cases of only ordinary severity, the iritis then runs its course without inflicting any permanent injury, and vision is completely restored as soon as resolution has taken place. When, on the contrary, the pupil cannot be dilated, the lymph deposited in the area of the pupil forms an impediment to vision; and the adhesions themselves tend to render the iritis a recurrent affection, which is apt to return again and again until the eye is disorganised and destroyed.

The first principle of treatment is, therefore, to produce and maintain dilatation of the pupil; and for this purpose it is necessary to use a watery solution of a salt of atropine. The neutral sulphate is the one best adapted for the purpose, and it should generally be of the strength of four grains to the ounce of distilled water. The pharmacopœial solution of atropia, which contains spirit, should be avoided on account of its irritating action. Of the pure watery solution, a drop should be carefully placed within the lids by a dropping-tube or quill, repeated in five minutes, and again in another five minutes, and this threefold application should be repeated three times a day. A mydriatic agent still more powerful and more rapid in its action than atropine has lately been introduced into practice in *duboisin*, the active principle of an Australian shrub, Duboisia myoporoides. Duboisin should be used in a watery solution, of the strength of four grains to the ounce; and it is said to have less tendency than atropine to produce local irritation. If the pupil can be fully dilated in twenty-four hours, no other treatment will be necessary than to maintain the dilatation by using atropine less frequently, and to protect the eye from being injured by exertion, or by exposure to great variations of temperature or of light. If, on the contrary, after the use of atropine for twenty-four hours, the pupil either remains contracted or dilates irregularly, showing that it is bound down here and there, it is necessary to have recourse to mercury without further delay, and to use one of the preparations, such as blue pill or calomel, with which the effect of the medicine upon the system can be rapidly secured. There is never any occasion to carry the effect of the mercury farther than to the formation of a slight line upon the gums; and, in most cases, as soon as this line is perceptible, a notable amelioration of the eye-symptoms will be observed. It is desirable, however, that this degree of mercurial influence should be reached quickly, in order to cut short the disease as soon as possible; and when it has been reached, it will usually require to be maintained, for some days at least, by the administration of smaller and less frequent doses. In favourable cases, under the combined influence of atropine and mercury, the effused lymph will be absorbed, the adhesions broken through, and the eye restored to its original condition. In those of a less favourable character the inflammation will, indeed, subside; but the adhesions will remain, and the pupil will be left permanently more or less crippled and distorted. Whether or not sight will be impaired will chiefly depend upon whether the effused lymph has formed a film or membrane across the pupillary opening. In the worst cases, notwithstanding treatment, the inflammation may extend to the ciliary body and choroid, and may produce functional destruction of the eye. This scarcely happens except when the iritis has been of great original severity, and when it has been neglected, or aggravated by irritants, in its early stages. Even the suspicion of iritis should absolutely preclude the use of the astringent applications on which we have mainly to rely in the treatment of the inflammations of the conjunctiva.

If an iritis is not seen until it has been three or four days in existence, so that the adhesions have had time to acquire a certain degree of firmness, it is not desirable to wait twenty-four hours before having recourse to mercury. The mineral should be given without further delay, so that it may be abandoned if atropine should dilate the pupil, and may be pushed if dilatation cannot be produced.

While the atropine, or atropine and mercury, are being employed, the remainder of the treatment must be governed by general considerations. Rest of the other eye must be strictly enforced; local depletion may be practised whenever the congestion is considerable in degree; and such a regimen and mode of life must be prescribed as the patient can bear. Unless there is photophobia, it is seldom or never necessary to exclude light altogether from the eye; and, when photophobia is present, it is better to apply a protective bandage than to keep the patient in a dark room. The latter practically excludes him from cheerful companionship, and leaves him to dwell upon his troubles in darkness and solitude. Pain, if present should always be subdued, either by combining a sufficient dose of opium with the mercury, or by the subcutaneous injection of a solution of morphia. However the anodyne is administered, provision should be made for repeating it sufficiently often to produce and maintain the desired effect.

When recovery takes place leaving adhesions, these will, in the majority of cases, lead to a second attack of iritis, and this is almost always

the predecessor of regular recurrence. In a few cases, however, the second attack does not follow; but, whenever it occurs, the tendency to future mischief should be stopped by surgical means, either by the detachment of the adhesions or by the performance of iridectomy.

(*b*) *Serous Iritis.*—The serous form of iritis differs from the plastic in the greater quantity and the more liquid condition of the effusion, which does not form adhesions, but distends the eyeball and compresses its contained structures. In a well-marked case the pupil is contracted and insensible to atropine (which in all probability is not absorbed); the aqueous humour is turbid; the iris is pushed back and its anterior surface appears concave; vision is greatly impaired; and the eyeball is perceptibly hardened to the touch.

Treatment.—Until the distension is relieved, no remedies will be effectual; and, when it is relieved, they generally cease to be needed. The treatment should be either by frequently repeated paracentesis of the anterior chamber or by a large iridectomy, and the latter is generally to be preferred. Serous iritis occurs chiefly in persons of unhealthy or broken-down constitution; which may perhaps account for the unorganizable character of its products. As soon as the distension of the eyeball is relieved, the pupil is readily dilated, and the iritis soon subsides.

(*c*) *Suppurative Iritis.*—In a small number of cases iritis assumes from the first a suppurative character, and leads to the formation of pus in the anterior chamber.

Treatment.—Such a condition calls for atropine; for stimulating and tonic medicines rather than for mercury; and for the evacuation of the pus by paracentesis if it is considerable in quantity, or if its presence appears to be a source of increased irritation.

2. *Inflammation of the ciliary body and choroid.* Synon.: Cyclitis; Irido-choroiditis.—In some instances, which fortunately are not numerous, iritis is not confined to the membrane in which it originates, but spreads backwards to the ciliary body and the choroid. The most marked examples are those in which the original inflammation has been excited by morbid changes, resulting sometimes from disease, but more frequently from injury, in the opposite eye; and these cases are called *sympathetic ophthalmia.* They have been abundantly shown to depend upon the propagation of peripheral irritation through a nervous centre, and they point very clearly to the presence of some central nerve-irritation, or functional failure, as the essential point of difference between the iritis which dies out as a localised affection, and that which spreads by continuity to the deeper parts of the eye. However occasioned, the issue of declared irido-cyclitis or irido-choroiditis is generally disastrous; for the inflammation is always of a plastic character, and the effused lymph is scarcely ever absorbed in time, or with sufficient completeness, to prevent its contraction from inflicting profound injury upon the visual apparatus. The perceptive layer of the retina is not only in contact with the choroid, but the rods and cones derive the materials of their nutrition from the chorio-capillaris; and hence, as regards these delicate structures, an inflammation of the choroid, upon which they are directly dependent, is of far greater importance than an inflammation of the retina itself, which may be limited to the connective tissue of the fibre-layer, and may leave the percipient elements almost unaffected.

Symptoms.—The first sign of the extension backwards of iritis is usually furnished by tenderness of the ciliary zone, so that this region feels acutely the slightest touch of a probe, or of the end of a rolled paper spill, which is a more delicate instrument for testing the sensibility of the ocular surface. At the same time there is always a greater degree of impairment of vision than the iritis alone will explain, together with increased general congestion of the eye, and, in many cases, with an appearance of visible vessels on the iris.

Treatment.—The treatment to be pursued does not differ materially from that which is required by the more severe forms of simple iritis; and consists of depletion from the temple, generally by means of Heurteloup's leech; the application of atropine; the administration of mercury, both internally and by inunction upon the brow; the control of pain; and the maintenance of strength. In sympathetic cases, the eye in which the mischief originated should be removed, even although the usefulness of this proceeding is somewhat doubtful when once the secondary affection is established. It is often necessary carefully to continue the use of mercury for a long period, generally in the form of small doses of the perchloride combined with iron; and it is chiefly when this has been done that some small vestige of vision is saved out of the wreck. The lens, in such cases, often becomes coated by lymph, and ultimately requires removal; and it may be necessary to perform iridectomy for closure of the pupil more than once, in consequence of the tendency of the artificial opening to be drawn together again by contraction. On account of the severity of sympathetic ophthalmia, and of its generally unfavourable termination, it is a rule of practice to anticipate its occurrence, and to remove a diseased or injured eye which is likely to produce it before the mischief has been done.

V. Diseases of the Crystalline Lens are separately treated of under the article Cataract.

VI. Glaucoma.—In its modern signification, this word is applied to denote all the conditions which are produced by a morbid increase of tension within the eye, that is to say, by an excess of its contained fluids; and the different forms of the affection are mainly due to differences in the rate at which the tension increases.

Symptoms.—If the increase be rapid, the loss of sight will be rapidly produced, and will be associated with other changes occasioned by sudden interference with the circulation and innervation, and by sudden stretching of the ocular tunics. When, on the other hand, the increase of tension is very gradual, so that the eye has time to become accustomed to the new conditions as they are produced, the symptoms often present a deceptive resemblance to simple atrophy; and these cases were at one time described as 'atrophy with excavation of the optic nerve.' In some of the more acute forms of increased tension, the

pupil presents a clouded aspect of a greenish colour; and it was to cases of this class that the word glaucoma (from γλαυκὸς, sea-green) was originally applied, at a time when the pathology of the condition was not understood. When this pathology was rendered clear, and when it became known that the glaucoma of the ancients was in all essential respects identical with cases in which the most manifest symptoms were of a different kind, the word was retained as a convenient general term, to express states of disease to which it had no longer any apparent reference; and hence we still speak of glaucoma, although, in the great majority of the cases in which we do so, the green aspect of the pupil is conspicuous by its absence.

The estimation of increased tension by the fingers is a matter which requires the *tactus eruditus*, and is best accomplished by directing the patient to close the eyes gently, and to cast them downwards. The tips of the two fore-fingers should then be placed upon the upper lid immediately below the margin of the orbit, and, when one finger has fixed the eye by holding it gently back against the orbital contents as far as it will recede, the other estimates the degree in which it may be dimpled by slight pressure. This degree varies to some extent in different persons within physiological limits, but a morbid increase of tension can scarcely be missed if it is looked for. Moreover, the diagnosis of glaucoma does not rest upon increased tension alone, but upon the combination of increased tension with decreasing sight. The rate of slow increase which may simulate atrophy, or of rapid increase which may simulate inflammation, are matters of detail which should not, in either case, be suffered to obscure the true nature of the morbid process.

Treatment.—The treatment of glaucoma is entirely surgical, the affection being capable of arrest by iridectomy or sclerotomy in the great majority of cases. In the more acute forms, an operation, if performed sufficiently early, usually restores vision to its integrity; but the time during which this can be done is limited, and in the more chronic forms no operation will do more than preserve what amount of sight is still retained. Hence it is important that treatment should not be delayed by any error of diagnosis; and the points to which attention should chiefly be directed, in any case of impairment of vision in which the question may arise, are increasing hardness of the eyeball as determined by palpation, and gradual contraction of the field of vision. Whenever the eye is becoming harder, and the circumferential extent of vision is narrowing in, the case is one in which an operation should be accomplished with as little delay as possible. At the same time, until the operation can be performed, a four-grain solution of eserine should be applied every four hours; this drug having a marked effect in controlling and diminishing tension. The more acute cases of glaucoma are attended by much pain from the distension of the ocular tunics, and often by congestion and inflammation, the results of this distension; and such cases were at one time described as 'acute internal arthritic ophthalmia,' or by some similar name. Vision has been irretrievably lost, in hundreds of cases, by endeavours to control this form of glaucoma by medical treatment, to the neglect of operation; and the erroneous practice has been kept alive by the circumstance that some of the cases will undergo partial and temporary amendment. In such circumstances, however, the vision never rises to the degree of acuteness which existed prior to the attack, and the amendment is never more than temporary. Another increase of tension soon occurs; and, without surgical aid, blindness sooner or later closes the scene.

VII. **Diseases of the Optic Nerve and Retina.**—As shown by the ophthalmoscope, these diseases cover a very wide field of pathology. In order to understand them accurately, it is necessary to bear in mind the anatomy and relative arrangement of the affected tissues. The optic nerve in the orbit is invested by a double sheath, and the interval between its layers, which is continuous with the sub-arachnoid space, terminates in a cul-de-sac towards the eyeball, the two layers becoming intimately united where they blend with the sclerotic. At this point, the opening in the sclerotic for the admission of the optic nerve is crossed by a film of perforated connective tissue, the *lamina cribrosa*, with which the sheaths of the nerve-fibres blend, or in which they are lost, so that the nerve anterior to the lamina consists of a bundle of unsheathed fibres, enveloping the central artery of the retina, which enters the eye with them, and the central vein of the retina, which passes out in the same position. On entering the eye the nerve-fibres bend round to form the anterior layer of the retina, which contains also the retinal blood-vessels almost to their ultimate divisions, together with some delicate connective tissue. The capillary circulation of the nerve itself is derived from the anterior cerebral artery, and is distinct, save for a very slight amount of anastomosis, from the capillary circulation of the sheath, which is fed by the arteries of the pia mater. It follows that hyperæmia of the sheath, or of the circle surrounding the nerve, may exist without hyperæmia of the proper nerve-tissue, and it has been supposed that fluid pressure in the intervaginal space may interpose an obstacle to the circulation in the vessels which pass through the sclerotic foramen, and may thus occasion dropsy of the termination of the nerve within the eye. Of the two foregoing conditions, either may undergo resolution harmlessly, or may produce such changes in or around the nerve as to occasion atrophy and loss of sight. Neither of them interferes with sight directly, because the circulation may be seriously disturbed by a degree of pressure which is insufficient to stop the conduction of impressions through the nerve-fibres. There is yet a third condition, properly called optic neuritis, or *neuritis descendens*, in which the capillary network of the nerve itself participates in changes propagated downwards from the cerebrum, and in which impairment of vision holds a very early place among the symptoms.

1. *Perineuritis.*—The true perineuritis, in which the unchanged nerve-disc is surrounded by a zone of high vascularity, is only seen as a

result of meningitis, which may be either tubercular or due to other causes. It was at one time hoped by Bouchut, by whom this especial phenomenon was first described, that perineuritis might serve as a diagnostic sign in cases of doubtful meningeal inflammation; but this expectation has not been realised. The perineuritis itself has only been observed in cases the character of which was scarcely doubtful, and which, in most instances, have terminated fatally. Very probably, however, it would be found, if looked for, in those cases of exanthematous and other fevers which are attended by cerebral symptoms, followed after recovery by impairment of vision. In these we eventually find, as a rule, a partial nerve-atrophy, which does not lead on to complete blindness, but which does not appear to be susceptible of improvement; and this partial atrophy may no doubt be due to the pressure of perineural exudation during its contracting stage.

Treatment.—The treatment of perineuritis must generally be that of the affection in which it has its origin; but, in any fever in which this symptom had been detected, it would be a question whether mercury should not be cautiously administered for a considerable time after convalescence, in order to promote the absorption of any effused lymph by which the optic nerve entrance might be constricted.

2. *Choked Disc.* Synon.: *Dropsy of the Optic Nerve Entrance.* This is a condition chiefly seen in connection with intracranial tumours, whether syphilitic, tubercular, or of some other kind; and it almost invariably affects both eyes. It was formerly supposed to be due to the pressure of fluid driven down the intervaginal space around the nerve, and so constricting the latter at the terminal *cul-de-sac* as to impede the outflow of venous blood. This hypothesis is now generally abandoned, but the condition visible with the ophthalmoscope is one of distension and tortuosity of the retinal veins; arrest of the capillary circulation; impediment to the arterial inflow; dropsical effusion into the disc-tissues; and, sometimes, secondary inflammatory changes, such as effusion and cell-proliferation, comparable to the erythema which occurs in the integument of a dropsical limb. All these changes may exist without impairment of vision, because they neither affect the perceptive layer of the retina, nor arrest the conduction through the nerve-fibres. At a later period, however, when any plastic elements in the exudation begin to undergo contraction, the interference with the circulation becomes more complete, the nerve-fibres themselves become compressed, and then failure of sight commonly occurs. At the same period, the nerve passes into a state of atrophy from the interference with its circulation; and these cases of nerve-atrophy were once sources of great perplexity to surgeons, and were referred to alcohol, tobacco, and to other causes which probably had very little to do with them. In consequence of the sight not being affected during the preliminary stage, the occurrence of this stage was for a long time absolutely overlooked, and was only discovered when physicians began to use the ophthalmoscope, as an ordinary instrument of diagnosis, in all cases of cerebral affection. It was then soon established, notably by the labours of Drs. Hughlings Jackson, Buzzard, and Clifford-Allbutt, that the atrophy had been preceded by swelling of the disc and by obstruction of its circulation; and it was shown before long that the cases of atrophy which had this history were recognisable, after the swelling had passed away, by the tortuosity of the retinal veins which was left behind, and by the way in which these veins were lifted into bold curves at the margin of the disc; this alteration of their original course having been due to the swelling, and remaining after the swelling had subsided. The contraction of the effusion, and the consequent atrophy of the nerve-fibres and closure of the capillary vessels, would be likely to occur earlier in some parts of the disc than in others; and hence, at the time when commencing failure of sight first induced the patient to seek advice on account of it, the disc was commonly seen to be invaded by sectors of whiteness, but to retain its vascularity, or perhaps more than its normal vascularity, in other parts; while, at the same time, the sight was first lost in those regions of the retina the fibres from which were first compressed. Hence it follows that a partial invasion of the disc by atrophic changes, and a partial invasion of the field of vision by blind portions, are among the earliest symptoms in cases of the class under consideration; and these symptoms were at one time referred rather to the nervous centres than to the retina or the disc itself, to changes in which they are now attributed. A not uncommon clinical history in such cases is that there has been constitutional syphilis, imperfectly treated, and ultimately producing headache or other cerebral symptoms, which have probably called for the administration of iodide of potassium and have been relieved by it. Some weeks afterwards there is for the first time a complaint of failing sight; and then the ophthalmoscope reveals that the discs are passing into atrophy, that the retinal veins are lifted into prominent curves at the disc-margins, and that their further course over the retina is generally serpentine. In many cases, the recovery of the patient, as far as general health is concerned, leaves the precise character of the intra-cranial mischief doubtful; but, in fatal cases, a tumour is the morbid condition most frequently discovered. *See* Ophthalmoscope in Medicine.

When the merely passive dropsical effusion into the disc becomes complicated with inflammatory changes, as results of the disturbance of the tissues, the sight begins to fail before atrophic changes become manifest; and such cases are very difficult to distinguish from those in which there is (3) *primary* or *descending neuritis.* The blood-supply of the optic nerve being derived from the anterior cerebral artery, we may reasonably expect to find capillary engorgement of the nerve-substance of the disc in connection with arterial hyperæmia of the brain; and this capillary engorgement may pass into inflammation, either of local origin or by transmission downwards from above. In any case, if the first changes in the disc are of the character of neuritis rather than of obstruction, we see capillary or arterial hyperæmia of the nerve-substance rather than venous congestion; and effusion of plastic material upon the disc itself, with comparatively little prominence

or disc-swelling, and with comparatively little extension over the disc-margins upon the surrounding retina. At the same time, even in the early stage of the affection, we find great impairment of sight, the conducting power of the nerve-fibres being seriously injured. Such cases are frequently syphilitic, and, unless the absorption of the effusion should be quickly brought about by treatment, its contraction, like that of the effusion of obstruction, soon occasions atrophic changes. In these cases, however, the swelling having been absent or inconsiderable, the vessels do not show that elevation into bold curves at the disc-margin which has already been described; and the contraction being interstitial in the nerve-substance, and from the first affecting veins and arteries in an equal degree, the arterial inflow is diminished *pari passu* with the diminution of the vein-channels, and the latter vessels are seldom distended in such a manner as to render them distinctly varicose or tortuous. The ultimate result is a white disc, on which the arteries and veins are dwindled to threads, or at least greatly reduced from their normal calibre.

We may therefore have three conditions which in their typical forms are tolerably distinct, but which are prone to run into one another by almost imperceptible gradations, and which may all lead on to atrophy and complete blindness: namely, perineuritis, neuritis, and choked disc. The liability to the last-mentioned condition should be carefully remembered by physicians, and should lead to careful ophthalmoscopic examination in all cases of obstinate headache or other cerebral symptoms of obscure origin, more especially in a patient with a syphilitic history.

Treatment.—It is manifest that the best hope of preventing ultimate blindness, in persons in whom choked disc has occurred, will be secured by the administration of medicines calculated to assist the absorption of the effusion, and by continuing these medicines, with comparatively small reference to the general symptoms, until the discs have cleared. The writer has seen such clearing occur, without loss of sight, in circumstances which rendered it almost certain that neglect of the disc-effusions would have been followed by blindness at no distant date. The same general rule will apply, of course, to the more directly inflammatory effusions of neuritis or perineuritis; and, when we find any one of the three conditions passing into atrophy, or when we find commencing atrophy in discs which show traces of past effusion, the principle of treatment is to endeavour to promote the absorption of any contracting material which may be the physical cause of the atrophy; and then, when this has been done, to seek to stimulate the nutrition of the nerve-fibres, and to assist them to recover from the shock which they have sustained. The mode of fulfilment of the first indication must depend mainly upon whether there is a history of syphilis, and, if so, upon the manner in which it has been treated. In the numerous cases in which a short course of mercury has been administered, enough to alleviate secondary symptoms, but wholly insufficient to eradicate the disease, it will generally be desirable to give iodide of potassium in full doses for a time, and to follow this by the prolonged administration of the perchloride of mercury, in the hope of really curing the patient. There are, in the writer's opinion, few things better worth remembering in therapeutics than that the iodide immeasurably the most valuable drug which we possess as a remedy for a late syphilitic symptom, is none the less almost useless as a remedy for constitutional syphilis. It will remove the present symptom, speedily and often completely; but it can scarcely be said to have any tendency to prevent the recurrence of syphilitic symptoms at a future time, in the same or in some different form. For this purpose, the only trustworthy agent is mercury; and therefore, while the administration of the iodide for a sufficient time, and in sufficient quantities to test its power of doing good, will be enough in the cases in which syphilis is neither known nor suspected, the iodide must be followed by mercury whenever a syphilitic history of the affection is either clear or highly probable. The second indication, to stimulate the nutrition of the nerve-fibres, is usually best accomplished by strychnia, given at such intervals and in such doses as to produce evidence of its constitutional effect before its administration is abandoned. It may perhaps be most effectually given by hypodermic injection; but this is a point which must be settled in accordance with the circumstances of the case in each individual instance.

3. *Sclerosis of the Optic Nerve.*—Besides the consecutive forms of atrophy above enumerated, there is yet another of common occurrence, which is either a primary sclerosis of the optic nerve, or a sclerosis secondary to a similar affection of other parts of the nervous centres. This form of atrophy is not preceded by effusion, nor is it attended by any marked decrease in the calibre of the central vessels of the retina, even when the capillary circulation of the disc has almost wholly disappeared. It is often seen in connection with disease of the spinal cord, as in locomotor ataxy; and also occurs in apparently healthy people, seemingly as a purely local affection.

Sclerosis is easily distinguished from the atrophies consecutive to effusion, whether active or passive, by the circumstance that the effusion, as it undergoes contraction, tends to render the nerve-tissues opaque as well as to bleach them, and thus leaves a disc-surface of an almost ivory whiteness and of uniform colour. In sclerosis, on the other hand, the nerve-tissue disappears to a great extent, and reveals the mottled surface, often of a bluish-white tint, of the lamina cribrosa. When this is plainly seen, and when, at the same time, the vessels are neither much diminished in calibre nor altered in their normal curvatures, sclerosis may be assumed to exist; and this form of atrophy may also be distinguished from that which is produced by the most chronic forms of glaucoma, by the circumstance that in the latter the vessels bend into the excavated disc at its margin, while in the former they pass over the margin in straight lines or nearly so. Chronic glaucoma would also be distinguished by the character of the failure of sight, which would be marked by regular or almost concentric contraction of the field of vision, even when central vision was only a little

impaired; and also by the gradual hardening of the eyeball, which would be present in glaucoma and absent in nerve-sclerosis. Still it cannot be denied that this particular diagnosis is not without its difficulties, and that in certain cases it has given rise to differences of opinion between men of large experience on all sides of the question at issue.

The diagnosis is important as well as difficult; since the mischief of glaucoma may admit of arrest by iridectomy or sclerotomy; so that to mistake chronic glaucoma for atrophy, and to neglect operation, may be to condemn the patient to unnecessary blindness. The opposite error can at least do no harm; and therefore, whenever a doubt really exists upon the point, the most proper course is to give the benefit of that doubt to the patient, and to advise the performance of an operation which cannot injure, and which may relieve him. The atrophy of sclerosis scarcely admits of treatment, but it may perhaps sometimes be delayed, or even prevented from becoming complete, by the administration of full doses of strychnia and iron.

4. *Atrophy from other causes.*—Besides the foregoing forms of atrophy, there is a variety which appears to be associated with chronic lead-poisoning, and in which the discs may acquire a peculiar gray or bluish tint; and the optic nerves may also undergo secondary wasting in consequence of other conditions presently to be mentioned, such as obstruction of the central artery by an embolus, or the long continuance of pigmentary retinitis.

5. *Retinal Hæmorrhage.*—The chief disorders of the retinal circulation displayed by the ophthalmoscope are hæmorrhages, which may be attended by very different circumstances, and may present widely different characters.

a. Single.—When blood proceeds from one of the larger veins of the retina, which yield a considerable quantity, and which are situated immediately underneath the limiting membrane, the hæmorrhage usually spreads out over the fundus as a red patch of uniform colour and aspect, and vision is suddenly, and sometimes almost totally, obscured. The writer has seen such bleeding occur from the yielding of a vessel during parturition; but this accident is extremely rare, and the large hæmorrhages in question are certainly more common in women at the period of cessation of the menstrual function than under any other circumstances. At this time, and when the health is not seriously affected, a favourable prognosis may be given with some confidence; for the blood will before long be absorbed, and restoration of vision, at least in a considerable degree, may be expected. The writer has once seen complete restoration to the normal standard, but this is an exceptional occurrence.

Treatment.—The only treatment necessary is to pay attention to the requirements of the general health; and to prescribe such diet, medicines, regimen, and habits as may tend to calm and equalise the circulation, and to prevent local congestions. The occurrence of sudden loss of sight in one eye will justify the suspicion of hæmorrhage; but the suspicion can only be converted into certainty by the ophthalmoscope.

b. Multiple.—A form of venous hæmorrhage which at first seems less formidable, because it is attended by a smaller degree of immediate interference with sight, but which calls for a less favourable prognosis, is that in which the hæmorrhages are multiple, often singly of small size, and scattered over the whole fundus of the eye. The appearances which they present differ, apparently in accordance with their precise position in the retina. If they proceed from vessels which are superficial, the blood is spread out, as in the last variety, in round or oval patches beneath the limiting membrane, but, if the vessels lie a little deeper, and are fairly engaged in the fibre-layer, the blood will separate the fibres and find its way between them, forming flame-shaped or brush-like patches, which are often very numerous. Such multiple hæmorrhages are very slowly absorbed, and have a tendency to recur; so that they must always be regarded as placing the sight in serious jeopardy. They are often monocular, and they do not point to any definite disturbance of the general health. The only endeavour so to connect them with which the writer is acquainted was made by Mr. Hutchinson, who described some cases of flame-shaped hæmorrhage in persons all of whom he said were 'gouty;' but it will certainly be the experience of most practitioners that flame-shaped hæmorrhages occur in many patients who are not 'gouty' in the ordinary sense, and that they do not occur in vast numbers of those about the reality of whose gout there can be no question. The presence of multiple hæmorrhages is sometimes attended by a considerable degree of irritation, or even inflammation, in the tissues among which the blood has been effused; and this condition, in which the retina between the blood-spots may become opalescent or turbid, has been described as a form of retinitis—*Retinitis apoplectica.* The element of inflammation, in such instances, is probably merely a reaction consequent upon the injury inflicted upon the tissues, and it cannot be inferred that the bleeding is itself the result of any inflammatory process.

Treatment.—In this, as in the former variety, there is no special indication for treatment, which must be confined to the correction of any manifest disorder of the general health, followed, in most instances, by the administration of iodides or bromides, as medicines calculated to assist in the absorption and removal of the effused products. Any indication of a general hæmorrhagic tendency, or of a state allied to purpura or scurvy, would require, of course, full consideration and appropriate treatment. The extent of the ultimate injury to sight will usually depend upon the extent to which the perceptive elements of the retina have been compressed or disorganised, either by the bleeding itself, or by other changes consecutive to it.

c. Arterial.—Hæmorrhages which are distinctly arterial are not uncommon in the fundus of the eye, and can generally be distinguished without difficulty from the venous variety, not only by the colour of the effused blood, but also by the situation of the bloodpatch, and by its manifest relations to a small arterial branch, which may often be seen to have dwindled or closed beyond the point at which it has given way. Arterial hæmorrhages are mostly multiple, but of

small individual extent; and, when not in the immediate neighbourhood of the optic disc, are most commonly seen near the outer limits of the ophthalmoscopic field of view. They are generally attended by sufficient impairment of vision to occasion complaint, and thus to lead to their detection; but they seldom occasion blindness. They call for an examination of the urine for albumen, and, failing any evidence of renal mischief, they are chiefly important as indications of a weakened and brittle state of the arterioles, likely to lead to intracranial hæmorrhage.

Treatment.—Arterial hæmorrhages into the retina point to the necessity of diminishing, as much as may be possible, the strain upon the arterial coats, by such means as the avoidance of muscular exertion or mental emotion, and by seeking to diminish the quantity of the circulating blood by a diminution in the quantity of fluid ingested. Even when all precautions have been taken, arterial retinal hæmorrhages are common forerunners of apoplexy.

6. *Embolism of the Central Artery of the Retina.* Embolism of the central artery of the retina, or of one of its branches, is a condition of not infrequent occurrence.

Symptoms.—When sudden blindness of one eye occurs in a person who is the subject of valvular disease of the heart, the diagnosis can scarcely be doubtful; but the ophthalmoscopic appearances will suffice to remove doubt if it should exist. The immediate effect of the sudden arrest of the arterial circulation of the retina is to render that membrane opaque and of a milky whiteness, except over the macula lutea, where the absence of connective tissue prevents any such change from being produced. Here, and here only, the original transparency is retained, and the colour of the choroid is seen through; with the result that the macula appears as a cherry-red spot in the midst of a white surface. When not concealed by the opacity, the larger veins of the retina are diminished in calibre and contents, and their blood is sometimes broken up into detached portions separated by interspaces. The arteries are empty, and are either invisible or traceable as white lines of fibrous tissue in the general milkiness of the fundus. The disc is usually bleached, but it will sometimes happen that its condition may be temporarily obscured by arterial hæmorrhage, occurring from some twig given off just below the seat of the embolus, and entering the eye independently.

The driving home of the embolus will throw upon such a twig the whole force of the circulatory *vis a tergo*, and may thus rupture it—an occurrence of which the writer has seen several examples. The blood so effused is usually absorbed in a very few days, revealing the white disc and the collapsed arteries, and removing any uncertainty which might have existed with regard to the diagnosis. The opalescence of the retina also disappears before long, and then only the secondary nerve-atrophy and the disappearance of the arteries remain to disclose the nature of the original affection. Embolism seems to be a perfectly hopeless condition, because there is no anastomosis between the retinal and other vessels of a sufficient extent to maintain a collateral circulation. The writer has met with one instance in which only a sector of the field was affected, and with one in which embolism of a very small branch produced loss of sight over all the peripheral parts of the field, leaving central vision almost intact; but such cases are among the curiosities of ophthalmology, and complete and permanent loss of sight of the affected eye is the result which must always be anticipated.

7. *Retinitis.* Retinitis is commonly described as occurring in three chief forms, the *albuminuric*, the *syphilitic*, and the *pigmentary*; but the writer is inclined to believe that only the last of these three is a genuine retinitis, and that in the others the inflammation, if it should exist, is merely a secondary consequence of the irritation produced by the presence of adventitious deposits.

a. Albuminuric Retinitis. In the so-called albuminuric retinitis, the sequence of events appears to lend some support to the contention of Sir William Gull and Dr. Sutton, to the effect that the renal disease is not an original affection, but only a result of morbid or degenerative changes which are common to the whole of the small arteries of the body.

Symptoms.—In many cases of albuminuria, the sight is not affected from first to last, and the retinæ remain healthy. In some, the retinal changes precede the appearance of albumen in the urine; and, in the majority, the renal and retinal changes are coincident. The retinal changes are of two kinds; namely, arterial hæmorrhages, occurring in the fibre-layer, so that the blood-patches assume a fibrillated aspect with brush-like terminations; and the formation of white patches, either of cholesterine deposit or of fatty degeneration, or of both combined, scattered irregularly over the fundus, but often grouped into a stellate figure around the macula lutea, and into an irregular ring around the disc. To these appearances are added, in some cases, those of swelling of the disc-margins with effusion into the retinal fibre-layer; and, when the last-named appearances are presented, there is always a far greater deterioration of sight than when they are absent. It is a matter of daily occurrence that the existence of renal disease is not suspected until impairment of sight leads to an ophthalmoscopic examination, and this to the discovery of the retinal changes; and, in every hospital, cases which apply for relief to the ophthalmic department are constantly, on this ground, transferred to the physician.

Treatment. — The treatment of the renal maladies which produce albuminuria is in no way modified on account of the presence of a retinal complication; and the unfavourable prognosis which must generally be given as regards life throws into comparative insignificance the gradual failure of vision, which seldom proceeds to complete blindness.

b. Syphilitic retinitis. This is usually an incident of the most advanced stages of the disease, and is most frequently seen in persons who have been inadequately treated during the primary stage, but who have for some months or even for a year or two been free from symptoms.

Symptoms.—Dimness of sight is then complained of, and the retina is found to present scattered patches of very irregular outline, and of a filmy whitish aspect. Such patches may

be more or less obscured by slight general turbidity of the retina itself, or of the vitreous body in its immediate vicinity, the latter condition being of itself almost conclusive of the nature of the malady.

Treatment.—The treatment must be greatly governed by the past history of the case, but may in most instances turn upon the use of iodide of potassium for the relief of the retinal troubles, followed by a sufficient course of mercury for the eradication of the syphilitic taint.

c. Pigmentary Retinitis. This appears to be a true inflammation of the retina, differing from the foregoing affections in that it attacks the percipient elements, instead of the fibre-layer or the connective tissue of the membrane.

Ætiology.—The subjects of pigmentary retinitis are of all ages, from nine or ten years to seventy; and, in some instances, the duration of the disease has been as much as twenty years, from the first appearance of the symptoms to their ultimate termination in blindness. As a rule, however, the patients are young adults, or persons not past middle age.

It is a remarkable feature of pigmentary retinitis that it almost invariably attacks more than one member of a family; and it has been said to be especially frequent in the offspring of marriages of consanguinity, but this statement is not borne out by English experience. During the last twenty years the writer has only met with one family in whom the malady had this history.

Anatomical Characters.—From the extreme chronicity of its course, from its obstinacy, and from its peculiar anatomical distribution, pigmentary retinitis should probably be regarded, together with some forms of choroiditis, as having its analogies among some of the chronic skin-diseases rather than with any other retinal affection. It commences in a narrow annulus near the equator of the eyeball, and gradually spreads inwards towards the optic disc; the tissues affected are the perceptive and pigmentary layers of the retina and the subjacent chorio-capillaris, which slowly become disorganised and matted together in one common and undistinguishable ruin. Coincidently with the progress of the disease, pigment is deposited in the parts affected, and in the retina superficial to them, in the form of irregular lines and striations, and especially along the course of the main arterial branches. As the annulus of disease gradually closes in upon the macula, the optic disc undergoes atrophy of a kind which gives it a peculiar tint of whiteness, very readily recognisable when it has once been noticed, and the central vessels, both veins and arteries, dwindle in size.

Symptoms.—The subjective symptoms are as characteristic as the ophthalmoscopic appearances. Over the region actually invaded, the perceptive elements of the retina are destroyed, and the power to receive visual impressions is lost. The fibre-layer not being implicated, the conduction of impressions from parts of the retina more peripheral than the disease may remain unaffected; and hence we may have a blind zone surrounding the centre of the field of vision, and surrounded itself by a zone still more external, in which dim vision is preserved. But the salient symptoms are two: the gradual contraction of the field of vision due to the progressive encroachments of the disease; and night-blindness, due to the nerve-atrophy, which interferes with the conduction or perception of any but strong impressions. When these symptoms co-exist, when the field of vision is small and becoming gradually smaller, and when the patient, who can still see fairly in the daytime, can scarcely find his way about as dusk begins to fall, we may predict the ophthalmoscopic appearances with a very near approach to certainty. The optic disc will be unnaturally pale, and the fundus overstrewn, towards the periphery, with irregular black lines and stripes, of which it is quite possible that none may be visible within that portion of the field of the ophthalmoscope which includes the disc.

Diagnosis. — Pigmentary retinitis may possibly be mistaken for the most chronic form of glaucoma, on account of the contraction of the field of vision; but it may be distinguished by the absence of high tension, by the night-blindness, and by the pigmentation of the retina. It may also be mistaken for the atrophy of sclerosis, but only if the ophthalmoscopic examination is limited to the nerve-disc, to the exclusion of the surrounding parts of the fundus.

Treatment.—In the treatment of a disease so essentially chronic, it is difficult to arrive at any trustworthy evidence concerning the efficacy of a remedy, but the prolonged administration of iron, rather as a food than as a medicine, is at least of a certain degree of utility in arresting the progress of the malady. The preparation employed is probably not material, and some may be found to suit particular persons better that others; but the writer is accustomed to begin with the tincture of the perchloride, in doses of five minims, well diluted and given three times a day as part of a meal.

8. *Detachment of the Retina.* Synon.:—Subretinal dropsy. This is a condition the causes of which have never been satisfactorily explained.

The first symptom which attracts the attention of the patient is the loss of part, usually either the upper or the lower part, of the field of vision; and it is manifest that loss of the upper part of the field means detachment of the lower part of the retina, and *vice versâ*. Detachment is sometimes produced by a blow or injury, but more frequently it occurs without any assignable cause, either local or constitutional. One or both eyes may be affected.

The diagnosis of the disease is rendered easy by the ophthalmoscope, which exhibits the detached portion as a sort of floating prominence, projecting into the interior of the eyeball, generally bluish-white in colour, and crossed by the retinal blood-vessels.

The prognosis is very unfavourable in the majority of instances, and treatment is seldom effectual.

Treatment. — Cases have been recorded in which disappearance of the sub-retinal fluid, and restoration of vision, have followed prolonged confinement in the supine posture; and the occurrence of improvement after spontaneous rupture of the detached portion suggested to Von Graefe

the advisability of producing such a rupture by artificial means. Various operations have been undertaken for this purpose, and also for the evacuation of the sub-retinal fluid through a puncture in the outer tunics of the eye, and are said by those who have performed them to have been in a few instances partially successful; but the evidence in their favour is at present very feeble, and hardly establishes more than that attempts of such a nature may be made, if it is certain that the sight will be irretrievably lost in the absence of interference. The tendency of detachment, especially in the upper portion of the retina, is to increase until the whole membrane is elevated from the choroid, aud vision is entirely destroyed. It must be borne in mind that detachment may be simulated, or may even be caused, by the growth of intra-ocular tumours, sarcomatous or gliomatous, which may demand the early removal of the eyeball. Such cases would be distinguished from simple detachment by the increased hardness of the eyeball, which the morbid growth would necessarily occasion, and which would be the more significant inasmuch as detachment alone is usually accompanied by diminished tension.

9. *Glioma.* This name has been given by Virchow to a malignant growth which has its origin in the neuroglia, or connective tissue of the nervous system, and which was formerly described as encephaloid cancer. When originating in the retina, it early produces loss of sight, and presently shows through the pupil as a substance of a primrose-yellow colour, by which the still transparent lens is pressed forward towards the cornea. It is chiefly a disease of childhood, and has been seen by the writer as early as the fifth week of infant life. It is liable, by superficial observers, to be mistaken for congenital or infantile cataract, an error which must be carefully guarded against, because the early and entire removal of the eye, together with as much of the optic nerve as can be reached, furnishes the only hope of preserving the life of the patient. When the operation is performed sufficiently early, it has in a few instances been completely successful, cases having been recorded in which no recurrence of cancer has happened after the lapse of years. In the great majority, however, recurrence and death have terminated the history.

10. *Sarcoma.* This differs from glioma in having its origin in the choroid, and in being of a darker colour, and sometimes pigmented or melanotic. It is at least equally malignant, produces similar symptoms, and requires the same treatment.

VIII. **Diseases of the Choroid.**—Diseases of the choroid, recognisable by the ophthalmoscope, are almost limited to certain chronic forms of inflammation and of atrophy; for, in any acute choroiditis, there is always too much turbidity of the vitreous body to allow the state of the membrane to be seen.

1. *Chronic Choroiditis.*—The chronic forms of choroiditis are remarkable for leading to an undue formation, or to a great displacement, of the choroidal pigment; and to the ultimate complete wasting and disappearance of the portions of the choroid which are affected, so that over these portions there will ultimately be no choroid visible, and the ordinary red colour of the fundus will be replaced by the ivory whiteness of the inner surface of the sclerotic.

Chronic choroiditis may be divided into two chief varieties, the *disseminated* and the *diffused.* The *disseminated* occurs chiefly in children, and chiefly, perhaps exclusively, in those who are the subjects of inherited syphilis. It is seldom seen until its period of activity is past. A child is brought on account of defective vision, which has probably existed from birth or from a time but little subsequent to it; and the ophthalmoscope displays a number of small white spots, with black borders, scattered irregularly over the fundus of the eye. The white spots are patches of choroidal atrophy, and the black borders are rings of increased pigment-formation, by which the spots of inflammation, which must have been comparable to little pimples, have been surrounded.

Treatment.—Such cases admit of no treatment, except in the rare instances in which some active mischief may be detected, in the shape of small patches or spots in which effusion has not yet passed into atrophy, and in which such an antisyphilitic treatment should be employed as the state of the patient may otherwise permit or indicate.

Diffused choroiditis is more frequently an affection of adult age; and, although very frequently syphilitic, is not invariably so. It differs from the foregoing chiefly in the absence of any defined shape or precise limitation of the parts affected. In the early stages the choroid is seen to be troubled by congestion or effusion, and these conditions pass gradually into abnormal pigmentation and atrophy. The course of the disease may be very chronic and irregular, and different stages of it may be seen at the same time in different parts of the same eye.

The prognosis may in general be moderately favourable; for, although the choroiditis destroys the portion of retina immediately in front of it, its extension is very capricious, and it may often be arrested in time to leave large portions of the eye, and especially the central portions, unhurt. When it occurs in the vicinity of the macula lutea, so as to imperil central vision, it is much more formidable than when confined to the more peripheral parts of the choroidal membrane.

Treatment.—Whenever there is a history of syphilis, this must be taken as the clue to treatment; and, if no syphilis can be discovered, the chief reliance must be placed upon rest of the eyes, occasional depletion from the temples by Heurteloup's leech, counter-irritation by blisters or setons, and such internal medication as the general state of the patient may suggest.

IX. **Diseases of the Vitreous Body.**—Diseases of the vitreous body are as yet very imperfectly understood, and we know little more concerning them than that this substance is liable to become turbid in certain forms of acute general inflammation of the eye; and that it is sometimes rendered turbid, without inflammation, by the presence of floating films which may be readily seen by the ophthalmoscope, and which may be so numerous as to form a serious impediment to vision.

1. *Turbidity.* Turbidity of the vitreous is very

common in syphilitic cases; but the films referred to are seen when no syphilis can be suspected. Their number, and their free movements, show that the vitreous must in great measure have lost its natural semi-solid consistence, and have become fluid; but little or nothing is known of their actual pathology.

Treatment.—The most effectual treatment for flocculi in the vitreous is usually diaphoresis by the subcutaneous injection of from two to four minims of a 10 per cent. solution of hydrochlorate of pilocarpine, which may be repeated on alternate days. Local counter-irritation with iodine may also be practised; and iodide of potassium may be given internally in such doses as circumstances will allow.

2. *Muscæ Volitantes.* A phenomenon referred to the vitreous body is the appearance of the moving particles, or strings of beaded filaments, which are commonly called *muscæ volitantes.* True muscæ are known by the negative character that the particles which produce them cannot be seen by the ophthalmoscope; and by the positive character that they never so intervene between the eye and an object, however small, as to exclude the latter from view. They are seen most readily against a white field, as a white wall, or a white cloud, or in the illuminated field of a microscope when there is no object in view; and they float about with uncertain movements, but always a little out of the direct line of sight. They are occasioned by the filamentous framework of the vitreous body, and by the cell-nuclei or other irregularities upon the filaments. These bodies, without being opaque, yet differ in the precise degree of their transparency from the fluid which surrounds them; and hence they cast upon the retina shadows, which are then mentally projected outwards into space as floating objects. The projected shadows appear, of course, enormously larger than the microscopic specks which produce them, and the latter are wholly unimportant and of no morbid signification. Muscæ may be discovered by any person by the simple expedient of looking through a very fine perforation in a metal disc at a bright surface; and they are more conspicuous to some persons than to others, on account of the varying differences which may exist in different eyes or in the same eyes at different times or under different conditions, between the index of refraction of the filaments and nuclei and that of the surrounding fluid. Moreover, by the operation of an obvious physical law, the more distant the particle from the retina, the larger will be its shadow upon that membrane, and the larger and more conspicuous will it appear. For this reason, and on account of the elongation of the myopic eyeball, muscæ are usually more complained of by the short-sighted than by others. They are often sources of great uneasiness to patients; but, when once their true character is known, they may be entirely disregarded as harmless appearances, the natural results of physiological structure. It is often important that the physician should be able to make their nature understood, in order that he may dissipate, once for all, the unfounded apprehensions which may be occasioned by their presence.

X. **Diseases of the Eyelids.**—The external surfaces of the eyelids, as parts of the common integument, are liable to all its diseases, and may thus participate in erysipelatous inflammation, in eruptions, and in the results of injury, besides becoming the seats of nævi, moles, warts, and other growths. Among the diseases special to the formation of the eyelids, the most important are the variations of shape to which they are subject, generally from the contraction of inflammatory exudations, but sometimes from perverted muscular action; the cystic tumours which are produced by obstruction of the orifices of meibomian glands; the inflammation of the follicles of the eyelashes, or blepharitis; spasmodic closure, from abnormal muscular contraction; and either patency or passive closure, from paralysis. Many of these affections are distinctly surgical, and others are only parts or symptoms of more general disorders.

1. *Blepharitis.* Blepharitis, or inflammation of the follicles of the eyelashes, has received a great variety of names from different writers, and is frequently known as *tinea tarsi*, or, in its more advanced stage, as *lippitudo.* The disease consists essentially of an inflammation of the lining membrane of a hair-follicle from which an eyelash springs.

Symptoms.—The first manifest symptoms are a small swelling close to the edge of the eyelid, generally of the upper lid; and the formation of a crust around the bases of the cilia which proceed from the swollen part. The swelling does not extend farther up the lid than to the breadth of about a line, but it soon spreads along the border until the whole length is involved, and it usually spreads also to the lower lid, manifestly in consequence of the contagious character of the discharge. If the crust is removed, and if the part from which it springs is magnified and carefully examined, it will be seen that the mouths of the follicles are somewhat open, no longer fitting closely to the issuing hairs; and, in a few moments, a clear fluid will be seen to exude, and speedily to dry into a crust or film, which covers the opening as if with a varnish. Many of the hairs in the affected follicles are loosened, and fall readily, or may be removed painlessly by slight traction. If the case is neglected, the follicles are before long destroyed as hair-bearing organs, so that the lost cilia are no longer reproduced; and, at the same time, the exudation which constitutes the subcutaneous swelling of the lid-margin begins to undergo contraction, and in this way gradually everts the cartilage of the lid. The edges of the lids become red, swollen, and unsightly; the lachrymal puncta are displaced outwards in such a manner that they can no longer take up the tears; the eyes have lost the protection of the lashes, and are exposed to numerous sources of irritation from atmospheric particles and other causes, so as to be especially prone to conjunctival and corneal inflammations; and these results are almost incurable. It is therefore very important that blepharitis should be effectually treated in its early stages, when, if only due care be taken in the selection and use of remedies, it is an exceedingly trivial affection.

Treatment.—The most essential part of the

treatment is to remember that the secretion which forms the crust is of such a nature that it is not very easy of removal, and that while it remains *in situ*, no remedies, however judiciously chosen, can obtain access to the parts really affected by the disease. The crust is composed partly of the already mentioned secretion from the inflamed surfaces, partly of the greasy secretion of the meibomian glands, and it is the admixture of the latter which renders the crusts difficult of removal by water alone. A solution of bicarbonate of soda, of the strength of five grains to the ounce of warm water, will remove them readily; and this solution should be applied in such a manner as to soak into the crusts and loosen them thoroughly before any attempt is made to detach them. As soon as they are detached, the surface beneath should be gently dried with a morsel of absorbent rag, and then an astringent should be applied immediately, so that it may find its way down into the depths of the hair-follicles, and may thus reach the seat of the malady. The best astringent is generally the ointment of the precipitated yellow oxide of mercury, or Pagenstecher's ointment, already recommended for the cure of ulcers of the cornea; and this may be applied to the affected part by the tip of a finger. If amendment does not speedily follow, it may be suspected that the crusts have been imperfectly removed, or the applications imperfectly made, and it will be well for the practitioner personally to superintend the process. When this has been done, if the affection continues obstinate, some other astringent should be tried, and the nitrate of silver is among the best for this purpose. Amendment of the lid-margin may generally be quickly produced; but the disease will for a long time lurk in the depths of the follicles, and the treatment must be continued until all subcutaneous swelling has disappeared from the lid-margins. Unless this be done, speedy relapse is inevitable, the inflammation soon creeping out of the follicles again and recovering the ground of which it had been deprived. Such a result is constantly seen in hospital practice, in spite of all efforts to guard against it, and, in undertaking the care of blepharitis, it is always desirable to warn parents of the perseverance which will be required, and of the great importance of obtaining a radical cure. There can be no doubt that blepharitis is exceedingly contagious through the medium of its secretion, conveyed upon sponges, towels, or fingers, and this should be fully recognised whenever it attacks children who are attending a school. The name 'tinea tarsi' may perhaps be taken as the expression of a belief that the disease is allied to tinea tonsurans, and that it is produced by the growth of a parasitic fungus. The writer does not at present see any sufficient ground for the adoption of this opinion.

2. *Entropium and ectropium.* Incurvation and excurvation of the eyelids may be looked upon as purely surgical maladies. The former exposes the eyes to injury from the irritation of inturned eyelashes (*trichiasis*); the latter from foreign bodies of various kinds.

Treatment.—The remedy for both, when any is practicable, must usually be sought in a surgical operation. An exception depends upon the fact that ectropium is sometimes produced by paralysis of the facial nerve, which renders the orbicularis muscle flaccid and powerless, and permits the lower lid to fall downwards under the influence of gravity. The cure of the general nerve-affection may restore the power of the muscle, and may in time lead to complete recovery of the natural position of the lid. In such cases, even if electricity does not form part of the general treatment of the paralysis, it may generally be applied with benefit to the orbicularis.

3. *Blepharospasmus.* This term is generally employed to denote an intermittent closure of the eyelids by an involuntary action of the orbicularis, in response to some concealed source of irritation; and is thus broadly distinguished from the spasm which accompanies photophobia.

Symptoms.—The spasm is most liable to occur in circumstances of mental excitement. Thus, in one of the writer's patients, who was a skilful cook, the eyes were apt to close, and to remain closed for some minutes, at the critical period of an important dish. Another patient was a schoolmistress, and the spasm would interrupt the progress of a lesson to a class, being doubtless to some extent excited by the dread of its occurrence. In a third case, the patient being a gentleman habituated to riding and driving, the spasm would be excited by physical irritants, such as wind or dust, and, almost certainly, by circumstances which required the eyes to be wide open as a condition of safe guidance. The motor nerves appear, as a rule, to be merely the passive conductors of a reflected impulse, and the trouble seems usually to be dependent upon a morbid condition of the fifth, or upon a source of irritation in some peripheral part from which a twig of the fifth passes to the centre.

Treatment.—In the treatment of such cases, it is sometimes possible to find the twig which conveys the impression; that is to say, to discover a point where pressure, sufficiently firm to arrest conduction, will at once relax the spasm. Such points should be looked for at the supra-orbital notch, over the malar bone, and in any other situation suggested by special circumstances; and, if a point at which pressure will arrest the spasm is discovered, we learn at once by what branch of the fifth, and therefore approximately from what region, the irritation is conveyed, and where its source is to be sought for. If nothing can be discovered by careful examination, decayed teeth, accumulations of cerumen in the ears, and conjunctival granulations are possible conditions which should be looked for, and which should receive attention if they are found. When all other treatment has failed, the spasm has sometimes been stopped by subcutaneous section of a sensory nerve; and this may always be practised hopefully if the spasm can be arrested by pressure on some definite spot, which must then serve for the guidance of the knife. If no such spot can be found, section of the supra-orbital nerve, and next of the subcutaneous malar, may be attempted; since neither of these are sufficiently important for their temporary disablement to be set against even the possibility of relief from a very distressing affection. In some cases, however, it would appear that the mischief must be central.

and that no section of an afferent nerve can be useful. The division of the motor nerves of the orbicular muscles, if it could be successfully accomplished, would produce a paralysis even more injurious than the spasm; and the cases in which the latter is due to central irritation or other trouble, unless they can be relieved by medicine, and by the rectification of whatever may be manifestly wrong in the condition of the patient, offer very small hope of improvement. *See* FACIAL SPASM.

4. *Ptosis.*—Ptosis is a condition of permanent passive closure of an upper eyelid as a consequence of paralysis of its levator muscle, or it may happen in consequence of this muscle having been torn from its attachment to the tarsal cartilage, so that it can no longer modify the position of the lid.

SYMPTOMS.—Paralytic ptosis may be either partial or complete, according to the degree of the nerve-affection; and as the levator palpebræ is supplied by the third nerve, which supplies also the superior, the internal, and the inferior rectus, as well as the inferior oblique, the sphincter pupillæ, and the ciliary muscle, ptosis is usually accompanied by paralysis of one or more of these muscles. When they are all affected, the eyeball is turned outwards by the action of the external rectus, and is immovable in other directions excepting feebly by the superior oblique. The pupil is dilated, and the power of adjusting the eye for near vision is impaired or lost, although when the lid is raised, near objects can still be distinctly seen by the aid of a convex lens. When all the muscles supplied by the third nerve are affected, the inference is that the cause of paralysis is acting upon the common trunk of the nerve; and such a cause is not unfrequently the presence of periosteal swelling at the sphenoidal fissure. If only some of the muscles are affected, the inference is that the cause of the paralysis is either limited to the central nuclei of origin of certain filaments, or else that it is situated anteriorly to the division of the main trunk into the branches which proceed to different parts; and it is conceivable that the limitations of the paralysis may point, with tolerable certainty, to the precise locality of the disorder.

The causes of ptosis, as of other paralytic affections of single cranial nerves, apart from injuries and the pressure of morbid growths, may almost be reduced to syphilis and to impaired nutrition of the centres, the latter usually connected with hard mental work and worry. In every case, evidence of syphilis should be carefully sought for; and, if found, should determine the nature of the treatment, as it will also of the prognosis, which, in such instances, may be generally favourable. In cases of the second class, where there is no evidence of syphilis, and where the symptoms point to general impairment of nervous energy, the administration of iodide of potassium, in combination with tonics, will sometimes be useful, but the main reliance must be placed upon rest, good living, and external surroundings favourable to the restoration of health.

5. *Diplopia.*—Double vision, although it has no proper relation to the subjects treated of in the present section, is yet so far allied to ptosis that, when occurring suddenly, it is almost always an effect of paralysis or of paresis either of the sixth nerve of one eye, supplying its external rectus, or of the branch of the third which supplies its internal rectus. In the former case the affected eye will deviate inwards, and will have limited range of movement towards the outer canthus; while in the latter case these conditions will be reversed.

As regards the causes and treatment of these limited forms of paralysis, there is nothing to add to what has already been stated about ptosis. It is sometimes desirable, while the diplopia continues, to exclude the deviating eye from vision by a shade, an opaque spectacle glass, or other suitable contrivance, on account of the vertigo and uncertainty of gait which may be occasioned by the double images.

See also EXOPHTHALMIC GOÎTRE; LACHRYMAL APPARATUS, Diseases of; LAGOPHTHALMOS; ORBIT, Diseases of; STRABISMUS; STYE; and VISION, Disorders of.

R. BRUDENELL CARTER.

F

FACIAL PARALYSIS.—SYNON.: Paralysis of the Portio dura; Bell's Paralysis.

DEFINITION.—Paralysis of the muscles of the face, due to disease or injury of the nucleus or fibres of the portio dura of the seventh pair of nerves.

Above the nucleus, in the middle of the pons, the motor tract decussates and mingles with that from the arm and leg; damage, therefore, in the upper part of the pons, crus, corpus striatum, or hemispheres produces facial paralysis as a part of hemiplegia. This paralysis, on the same side as in the limbs, is partial only, affecting chiefly the muscles of unilateral use (as the zygomatici and muscles about the angle of the mouth); and very little those of bilateral use, in the upper part of the face (orbiculares palpebrarum, and frontales). In this article paralysis from damage to the fibres or nucleus of the nerve will alone be considered.

ÆTIOLOGY.—(1) The most common cause of facial paralysis is damage to the nerve as it passes through the narrow canal in the temporal bone. There the slightest effusion will cause pressure on the nerve. Such effusion may be due to exposure to cold—'rheumatic;' contiguous bone-disease—caries; syphilis; or hæmorrhage; but often occurs without discoverable cause. Cold has been supposed to act most commonly by paralysing the peripheral nerve-twigs, but

this is rarely, if ever, the case; since in all cases lasting more than a few days, evidence of changed nutrition may be detected in the nerve-trunk as it emerges from the stylomastoid foramen. (2) Injury to the nerve outside the skull by blows, or incised wounds, or parotid and other tumours, is an occasional cause. (3) Within the skull the nerve may be damaged by meningitis, acute or chronic, and especially by syphilitic inflammation, or by pressure of neighbouring growths. The radicular fibres within the pons, or the nucleus beneath the fourth ventricle, may be damaged by hæmorrhage, softening, or growth affecting that part.

Double facial paralysis is very rare, and is due to damage to the nerves at the base of the brain from meningitis, or symmetrical syphilitic disease; or to an affection of the nuclei by disease of the pons, or by loss of function of the nerve-cells composing the nuclei. Syphilis and diphtheria are the most common antecedents.

Symptoms.—The onset of facial paralysis is usually gradual, occupying from a few hours to three or four days in its development. It is found, for instance, one morning that in drinking the fluids run out of the side of the mouth; the face is noticed to be a little unsymmetrical; at night the eye cannot be completely closed; and next morning the paralysis is found to be complete.

In complete unilateral facial paralysis all the muscles on one side of the face are paralysed. At rest, the smooth forehead and lowered angle of the mouth are the chief indications, but on movement the difference between the two sides becomes very marked; the one half of the forehead moves alone in frowning or elevation of the eyebrow. The eyelids cannot be brought together, and in the attempt to close the eye the eyeball is rolled upwards so that only the sclerotic appears between the gaping lids; the patient commonly imagining that the eye is shut. During sleep the eye remains open. In smiling, the lips may be displaced altogether to the healthy side, from the unopposed action of the zygomatic muscles, the nostril of the affected side cannot be dilated, the upper lip cannot be raised, the cheek flaps loosely from the relaxation of the buccinator, and from the same cause food accumulates between the jaws and the cheek. Whistling is impossible, from the paralysis of half of the orbicularis, and the lips cannot be approximated sufficiently even to permit of a candle being blown out. When the lesion is between the origin of the large petrosal and the chorda tympani nerves, taste is partly or entirely lost in the front of the tongue. The loss of power of recognising acid and saline substances is most marked, but bitters and sweets are also not tasted in this part. In rare instances loss of taste has followed division of the nerve outside the skull. When the disease is above the origin of the great superficial petrosal, the uvula is said to be oblique, from paralysis of its muscle, and the palate to be motionless on that side. Of this there is much doubt. Obliquity of the uvula is common under normal conditions. The writer has never seen paralysis of the palate or uvula in these cases.

In some cases giddiness marks the onset of facial paralysis. In less severe cases there may not be complete loss of power, but the loss is at first pretty equally distributed over all parts of the face.

In cases which recover, some return of power takes place in from a week to two months, and improvement is usually earliest in the upper part of the face; the power of frowning, winking, and closing the eye being soonest regained, that of moving the lip and mouth returning last. Even after several months of immobility, recovery may take place, but in these cases it is rarely complete, and a troublesome condition is apt to supervene; some of the muscles, especially the zygomatici, become shortened in late rigidity, and hence at rest the naso-labial wrinkle is deeper on the paralysed than on the healthy side, although the possible movement may be much slighter. This condition sometimes comes on rather suddenly. If, in addition, a troublesome associated over-action of muscle manifests itself, whereby the orbicularis palpebrarum and the zygomatic and other muscles about the mouth act together, in smiling the eye shuts, and on closing the eye the mouth is drawn upwards.

The electrical condition of the muscles is very important. It is that always seen in paralysis from nerve-lesion. The muscles, after a day or two of slightly increased irritability to both faradisation and the slowly interrupted battery current, lose gradually their irritability to the former, retaining that to the latter, and even exhibiting to it increased irritability, so that they act to a smaller number of cells than on the healthy side. In the nerve, on the other hand, the irritability is lost to both forms of electricity, this loss proceeding *pari passu* with the degeneration which follows separation of the nerve from its nutrient centre. In slighter and more transient forms of facial paralysis the change in irritability of muscle and nerve may be slight, but even in most, which last but a few days, a slight change in irritability may be discovered.

Diagnosis.—The diagnosis of facial paralysis is easy. It is important to observe all the muscles of the face, and to ascertain the electrical reaction, in order to determine whether it is the variety now described, or is cerebral and part of an unnoticed hemiplegia. The recognition of the place of the lesion is less easy. When within the pons, it is often associated with paralysis of the sixth nerve, or with hemiplegia of the opposite side from damage to the fibres from the limbs. At the base of the brain the auditory nerve is usually affected at the same time. Where there are no other paralyses, the disease is probably within the bony canal. Deviation of the uvula is a guide of most doubtful value. Special inquiry should be made for ear-disease, for syphilis, or for a blow.

Prognosis.—The majority of cases of facial paralysis are due to rheumatic affection of the nerve, and recover, but the duration of some of these is considerable. In recent syphilitic cases the prognosis is good. In caries of the temporal bone and in intracranial disease, unless syphilitic and recent, the prognosis is less favourable. Whatever be the cause, the electrical reaction of the nerve and muscles affords valuable informa-

tion, since in proportion to the slightness of the change in relation to the length of time the symptoms have lasted, will the degree and duration of the affection be less.

In double facial paralysis the probability of central mischief will render the prognosis less favourable, but recovery may be hoped for if there are no symptoms of disease damaging tructures contiguous in position, and not merely related in function, and if the disease be of short duration.

Treatment.—The treatment of facial paralysis will depend on the probable cause. When due to the effects of cold, hot fomentations to the side of the head and face may be employed in the early stage of the affection, and afterwards counter-irritation by blisters behind the ear. At first, diuretics and small doses of iodide of potassium, and subsequently tonics, are useful. Electricity to the muscle and the nerve is of great service; faradisation should be used if the muscles will respond to it; if not, the voltaic current, slowly interrupted by a commutator, or by the negative pole being moved over the individual muscles, and only such strength being employed as shall produce distinct muscular contraction. If the faradic irritability be lost at first it will return as the muscles recover, and faradisation should then be employed. If electricity does no more, it keeps up the nutrition of the muscular fibres and aids the recovery of function in the nerve. Ultimate recovery is thus more speedy and more complete than without local treatment. Rubbing may be employed, the individual muscles being subjected to a process of gentle shampooing. The treatment of the late contraction which occurs in severe cases is often difficult. Faradisation of the opposite side of the face has been suggested, but can scarcely be of service. The zygomatic muscles may be elongated a little by frequent gentle traction, and the other contracted muscles should be gently rubbed, so as to lengthen them. Inunctions of oleate of morphia may be tried. The muscles that are contracted should not be faradised. The condition usually lessens after a time, but often remains for many months, or even years.

Where facial paralysis is due to syphilis, it usually readily yields to antisyphilitic treatment, if recent; but even here electricity is useful, since degeneration of nerve and muscle rapidly occurs. In intracranial disease the treatment of the facial paralysis is usually subordinate to that of its cause. When there is indication of sudden and increasing mischief at the nucleus of the nerve, galvanism must be employed with caution.

The treatment of double facial paralysis presents no special points for consideration.

W. R. Gowers.

FACIAL SPASM.—Synon.: Mimic cramp. Fr. *Tic convulsif.* When affecting the eyelids, Blepharospasm; Nictitation.

Definition.—Spasm, sometimes tonic but more often clonic, involving some of or all the muscles supplied by the facial nerve.

Ætiology and Symptoms.—Spasm in the face may be part of a wider convulsive movement, as in epilepsy, hysteria, chorea, or torticollis, diseases dependent on central change. Secondly, it may be due to irritation of the trunk of the facial nerve by growths, pressure, or caries of the temporal bone. Spasm of this form may follow facial paralysis. Thirdly, it is very commonly reflex, produced by the application of cold, by intestinal worms, or especially by some disease or injury of the fifth nerve. Affections of the eye frequently lead to spasmodic closure of the lids—*blepharospasm.* Lastly, in other cases no cause can be assigned for it, especially in the local clonic spasm affecting the eyelids—one or both—and known as involuntary winking or *nictitation.* The latter form is seen especially in neurotic persons; in nervous children it is not uncommon, and in hysterical girls. It is markedly increased by emotion and attention. All forms cease during sleep.

Prognosis.—The prognosis of facial spasm is good, if the cause can be discovered. Where there is no discoverable source of reflex irritation the affection is often most obstinate.

Treatment.—General tonics and local sedatives are the most important elements in the treatment of most forms of facial spasm. When irritation affects the fifth or the facial nerve, counter-irritation by blisters is useful. A careful search must be made for reflex or other causes, and if possible they must be removed, decayed teeth extracted, and neuralgia relieved. When there are tender places in the course of the fifth nerve, pressure on which stops the spasm, much improvement can usually be obtained. Morphia, belladonna, and aconite are the best local sedatives; the former may be used as a hypodermic injection or by inunction. Arsenic may be injected in some cases with advantage. Iron and quinine are useful, especially the latter. Bromides and phosphorus are of little value. Where the affection runs into an habitual movement, facial gymnastics may be of service. A weak voltaic current, applied from the ear to the muscles, unbroken, may do some good; but it rarely, if ever, affects a cure. The same is true of the application of voltaism to the sympathetic. *See* Eye, and its Appendages, Diseases of.

W. R. Gowers.

FACIES HIPPOCRATICA (Latin).—A peculiar expression of the face, so named from having been graphically described by Hippocrates. It is most strikingly observed in persons exhausted by copious discharges, as in cholera, by prolonged wasting diseases, or by starvation; and especially before impending death. It is thus described by Hippocrates:—'A sharp nose, hollow eyes, collapsed temples; the ears cold, contracted, and their lobes turned out; the skin about the forehead being rough, distended, and parched; the colour of the whole face being green, black, livid, or lead-coloured.'

FÆCES, Examination of.—An examination of the fæces frequently affords valuable evidence of the condition of the organs engaged in the process of digestion, and furnishes important data on which to found a diagnosis, and suggest a rational treatment. Not only may structural changes in the alimentary tract be discovered, but also the completeness of action of the various

digestive juices be recognised. As with the examination of the renal secretions, a previous knowledge of the healthy characteristics is an essential; that being granted, the investigation may be pursued on the same lines in both cases, as regards the general, microscopic, and chemical characters. Since, however, these characters are more directly dependent on the ingesta, and less upon the excretions, their examination cannot be so valuable an index of tissue-change as is the investigation of the urine.

I. **Physical examination.** — 1. QUANTITY. This is extremely variable. Taking the normal average for an adult to be about 5 ounces daily, it may vary from 2½ to 10½ ounces. The quantity would seem to bear no relation to the size or weight of the individual, but is rather influenced by the quantity and kind of food, and the activity of the secretions of the alimentary canal. As a rule, the amount is increased by a vegetable diet. In children it would seem the total daily amount is relatively slightly greater, whilst in old age there is an absolute diminution. When in disease the quantity is increased it is chiefly of the fluid portion, whilst a diminution affects both the solid and fluid parts. Tea is said to diminish the quantity of the fæces (Chambers). *See* CONSTIPATION, and DIARRHŒA.

2. CONSISTENCE AND APPEARANCE,— Departures from the normal cylindrical shape are frequent, and depend very much on the existence of constipation or diarrhœa. In infants the evacuations should be unformed and of a pappy consistency. The contents of the bowels pass from a semifluid condition in the ileum to the firmer state in the colon, mainly from an absorption of fluid constituents; should there be any delay in the passage the motions are liable to become hard and nodular (scybala), and this may occasionally be extreme, the fæces having all the appearance of sheep's dung, and being passed with considerable pain. On the other hand, an increased frequency of action of the bowels (diarrhœa), is associated with motions of all degrees of fluidity. This is very marked in the various forms of irritation to which the intestinal mucous membrane is liable, from the simple effects of a saline purge to the extreme conditions of ulceration, as in typhoid fever or dysentery.

The existence of hæmorrhoids, rectal growths, or an enlarged prostate, may be recognised by groovings and marks on the excrement. Among drugs, iron and vegetable astringents will render the fæces hard and firm. Occasionally the motions are passed in a fermenting condition, due to the presence of sarcinæ, and present a frothy brown, or yeast-like, appearance, similar to certain vomits.

3. COLOUR.—This is dependent on the bile-pigments, and is subject to considerable variation even within the limits of health. The usual brown colour becomes much darker if long retained, or with an exclusively meat diet, and pale yellow with milk food, as seen in infants, and tends towards a greenish tint when vegetables form the bulk of the food.

The most important abnormal causes affecting the colour are the following:—

(*α*) *Bile.*—Obstruction to the passage of bile into the duodenum, causing the motions to be clay-coloured, or putty-like. Such evacuations are often combined with distinctly bile-coloured fluid, which is secreted by the mucous membrane of the bowels from the bile-laden blood, &c., as is the coincident high-coloured urine. In extreme anæmia and the rickety cachexia the stools are usually pale from deficiency of bile-pigment.

(*β*) *Blood.*—This may either appear as streaks or patches of pure blood on the surface of the motion, as is the case when hæmorrhoids or ulceration of the rectum exists. Or the fæces may be of a uniform brick-red or almost black colour when there has been a hæmorrhage from the intestinal surface, the blood becoming intimately mixed with the fæces, and more or less affected by the sulpheretted hydrogen of the bowels, forming a black sulphide of iron. If the blood has escaped into the stomach the action of the gastric juice on the blood-pigments is such as to convert the fæces into a tarry-looking material of a very characteristic appearance. *See* MELÆNA.

(*γ*) *Articles of Diet, Drugs, &c.*—Among the former may be mentioned spinach, coffee, claret, and porter, which confer on the excrement their characteristic tints. Among the latter, logwood and charcoal may be detected by their colour in the fæces. Salts of iron and bismuth, by being converted into the sulphides, render the motions black or olive-green.

The exact cause of the green stools so frequently seen in children during dentition is uncertain; whether it be due to a direct conversion of blood that has been slowly effused into the alimentary canal, by the digestive juices and gases, or whether it be bile-pigment altered by these same agents. Inasmuch as the biliary colouring matters are more or less directly obtained from the hæmatin of the blood, the original source of this green colour (biliverdin) is the same in both cases. But its occurrence cannot be certainly taken as an indication of increased secretion of bile, for it possibly may depend on a diminished absorption.

4. ODOUR.—The characteristic odour of the fæces is in part due to certain substances developed during pancreatic digestion and partly to special secretions from the glands of the colon, as well as to certain articles of diet such as garlic, or of medicine such as sulphur. Disturbance of either of the above conditions will affect the odour. Absence of bile from the alimentary canal, by interfering with the pancreatic digestion, and also by the want of its own special antiputrescent power, is accompanied with very ill-smelling motions. In this case the fæces may be almost putrid, which is not a normal condition. This state is still more marked in certain diseases of the colon, as dysentery, when the evacuations are of a most foul and acrid character. In children the alvine discharges are very apt to be offensive from errors in diet, or to emit a peculiar sour odour.

5. FOREIGN BODIES.—By inspection of the evacuations we may discover:

(*a*) Substances *accidentally* swallowed, such as coins, pins, &c.

(*b*) *Indigestible food*, such as fish-bones, cherry-stones, &c.

(*c*) *Undigested food.*—Portions of food that

have escaped digestion. In certain severe disturbances of the digestive functions some of the food may be passed scarcely, if at all, altered soon after ingestion, and may be easily recognised. This condition, known as lientery, is especially prone to occur in the intestinal catarrh of young children during dentition.

(*d*) *Fatty or soapy masses.*—These may follow the administration of oils—castor, cod-liver, &c. They are more likely to occur when the biliary and pancreatic secretions are deficient, and appear as nodular masses, as large as filberts, or as cylindrical pieces, which have been compared to macaroni. Curdy lumps derived from milk are often met with in infantile diarrhœa.

(*e*) *Entozoa*, such as segments of tænia, the various round-worms, or the contents of hydatid cysts that may have burst into the canal.

(*f*) *Gall-stones, intestinal concretions, mucous or membranous casts of the intestines, portions of bowel sloughed off from intussusception, &c.*

II. **Microscopical examination.**

Method.—The evacuations, when of ordinary consistency, require to be shaken up with two or three times their bulk of distilled water and allowed to stand. This may be repeated several times, and the washings successively submitted to microscopic examination, as well as the final sediment. When the discharges are very fluid this process is not needed.

Constituents.—The usual microscopic constituents of the fæces are—

(*a*) *Undigested and indigestible residues of the food.* Such are starch-cells, woody fibres, particles of husks of corn and other seeds; muscular fibres with their characteristic structure and generally bile-stained; shreds of elastic tissue and fibres from the blood-vessels; portions of cartilage; hairs.

(*β*) *Epithelium.* — This is derived from the mucous membrane of the canal. The cells may be more or less distinct and separate, or form by cohesion amorphous yellowish masses which constitute a considerable portion of the solid matter.

(*γ*) *Oil.*—Occasional oil-globules are seen.

(*δ*) *Crystals of triple phosphates.*

(*ε*) *Amorphous granular matter.*

Since the nature of the food varies so widely it is impossible to state anything in regard to the relative proportions in which these objects occur. In certain states they are found absent or in excess. When from any cause the fats are imperfectly digested they may be recognised in the discharges. Crystals of ammonio-magnesian phosphates are very abundant in typhoid evacuations. The spores of fungi, and the ova of intestinal parasites, and the hooklets of hydatids may be met with, and bacteria would seem to be very frequent, possibly in connection with pancreatic digestion.

III. **Chemical examination.**—The imperfect knowledge we possess of the actual chemistry of the tissues and secretions, with the exceeding variety in the composition of the ingesta, prevents our obtaining, from any analysis of the fæces, much information of a practical character. It is seldom if ever that such examination furnishes evidence of primary importance, as does the urine; it is only occasionally that the results correspond to what other signs and symptoms indicate to be the case.

On an average the fæces contain about 23 per cent. of solid matter to 77 per cent. water, but this proportion is liable to the widest variations both in health and disease. Thus in cholera-stools the solid residue may be but a few grains per pint.

1. Special Constituents.—Two bodies—excretin and stercorin—have been described as characteristic of the fæces. Both are non-nitrogenous, crystallizable, non-saponifiable bodies, the former containing sulphur. They differ in their crystalline form and solubility in alcohol and ether. They appear to be closely related to cholesterin, with which in many points they agree. It is found that when the bile which normally contains cholesterin is prevented reaching the intestines, that neither of these bodies occur in the fæces; and that they are also absent, being replaced by cholesterin in the meconium, and in starving and hybernating animals, when there is no obstruction in the bile-flow. Flint considers about ten grains per diem to be the average amount of stercorin and the excretin of Marcet to be about a fifth of that. Cholesterin itself, except in very small quantities, cannot be regarded as a normal constituent of the fæces, but the precise significance of its occurrence is uncertain.

2. Fatty Acids, Fats and Soaps.—Excretolic acid, one of the fatty series, is described by Marcet as a constant ingredient. Free stearic and margaric acids only occur in minute proportions, in ordinary circumstances, but are readily increased to considerable amounts when the alkaline secretions of the liver and pancreas are prevented entering the intestines. A vegetable diet is also said to increase them. Butyric acid does not seem to be of normal occurrence in human fæces. The presence of neutral fats in the excrement may be taken to indicate that there has been excessive ingestion or a diminished digestion, since under ordinary circumstances they would be absorbed. The soda and potash soaps ordinarily formed by the ingested fats with the bile and pancreatic juices should be in great part taken up by the lacteals; but a portion meeting with any lime or magnesian salts that may be in the alimentary canal, form with them insoluble hard soaps which are passed in the fæces. Marcet describes a case in which a large quantity of bi-stearate of soda was voided, the bile and pancreatic juices having been absent from the intestine.

3. Salts.—They form but a small amount, and are chiefly the earthy and triple phosphates, with small quantities of iron and silica; there is a marked absence of chlorides. When the stools are very alkaline the triple phosphates may be very abundant, and in cholera-discharges the whole amount of salts is largely increased, there being nearly an ounce in every hundred fluid ounces of evacuation, a large proportion of which consists of chlorides.

4. Pigment.—The ordinary colour of the fæces is due to a modification of the bile-pigments, but the exact nature of the change is unknown. The absence of colour from the discharges when there is an arrest of bile-flow has been referred

to; but though clay-coloured stools as a rule do indicate such arrest it is not invariably so, for the writer has met with a case in which normally coloured fæces in the small intestines were absolutely deprived of their pigment in passing over a diseased portion of the lower end of the ileum.

5. Mucus, Albumen, &c.—There is usually a small amount of mucus passed with the fæces, and this may be considerable in amount, resembling jelly, when any irritation of the rectum or colon exists, or occasionally more condensed, forming cylindrical casts of portions of the canal.

Albumen as such can scarcely be looked upon as a normal ingredient of the evacuations, but the fluid part of cholera-stools, which resembles blood-serum in composition, contains a very appreciable quantity.

Ferments similar in action to ptyalin and pepsin are described as existing in the fæces, but how they may be modified in disease is quite unknown.

Next to the undigested and indigestible residues of food, the fæces may be regarded as an excretory channel of certain materials from the blood by means of the bile. The other digestive juices are probably re-absorbed. As an index, however, of bile-excretion, the fæces are very unreliable, inasmuch as no ingredient of the bile is normally found in them as such. Whether pigment, bile-acids, or cholestearin, they all undergo a change. The occurrence, therefore, of any of these materials in the alvine discharges may be taken as evidence that the changes in the biliary constituents which should take place in the intestines are interfered with.

6. Reaction.—As a rule, the reaction of the fæces is acid, showing that there is no putrid decomposition. Occasionally, however, it may be slightly alkaline. When the strongly alkaline secretions of the liver and pancreas are prevented through obstruction or disease from entering the canal, the motions may be strongly acid from the existence of free fatty acids.

For the **Diagnostic Characters of the Fæces in disease**, *see* Stools, Characters of.

W. H. Allchin.

FÆCES, Involuntary Discharge of.—Under normal circumstances the fæces are retained within the rectum by the closure of the sphincter ani. When defæcation takes place the sphincter is relaxed, there is increased peristalsis of the lower bowel, and there is pressure on the intestines, from the contraction of the expiratory muscles with the glottis closed. The nerve-governance of these three phases of the act is different in each case. The contraction of the abdominal muscles is mainly due to an effort of the will. The activity of the colon and rectum is reflex, from irritation of the intestinal ganglia by the accumulated fæces. Lastly, the relaxation of the sphincter depends on the inhibition of the tonic centre in the lumbar enlargement of the spinal cord; such inhibition being brought about either in a reflex manner from the rectum or directly from the cerebral centres. It is obvious that the relaxation of the sphincter is the most important stage in the act, for until that takes place no discharge can occur. Up to a certain point the increased peristalsis and pressure on the bowels may be resisted by a voluntarily increased contraction of the sphincter, but at a certain stage the inhibiting influence is exerted, and relaxation results. Since this influence is beyond the control of the will, it would follow that the chief causes of the involuntary discharge of the fæces are to be found in those conditions which interfere with the normal tonicity of the sphincter. At the same time, any circumstances which may increase the pressure of the abdominal muscles or the activity of the bowels much beyond what ordinarily occurs, may lead to an involuntary discharge.

Ætiology.—The causes of involuntary discharge of fæces may be thus tabulated:—

1. *Violent contraction of the expiratory muscles*, such as may be induced by strychnia-poisoning. It is of rare occurrence in tetanus.

2. *Increased peristaltic action* of the intestines. This is chiefly dependent on causes of irritation situate in the bowels themselves, such as inflammation or ulceration of the walls; irritating contents; worms, &c. Extreme fluidity of the fæces is frequently sufficient to induce their partially involuntary discharge, and is noticeable in the diarrhœa of infants and children.

3. *Abnormal relaxation of the sphincter ani.* As already said, the previous mentioned causes are powerless to produce the discharge of the fæces until the sphincter yields; and how far the sphincter may relax as a result of their efforts, or independent of them, is not easy to determine. The nervous influence emanating from the lumbar centre which normally determines the tonic state of the sphincter may be inhibited—

α. *Reflexly*, as from worms, fissure of the anus, or calculus vesicæ. It is quite true that the immediate result of irritating the sphincter is to determine in a reflex manner an increase of its contraction, as may be experienced in introducing instruments, &c., into the rectum; but it would also seem that at a certain point the irritation may lead to an arrest of the tonic influence, and so allow the sphincter to yield, and this is particularly the case with affections of the bladder.

β. *From cerebral disease.* That certain emotional conditions may lead to involuntary defæcation is well known, and that a similar result follows some diseases of the cerebral centres is not uncommon. The paralysis of the sphincter that occurs under these circumstances is brought about by inhibiting the normal tonic stimulus emanating from the lumbar centres. Involuntary evacuations frequently occur in epileptic fits; in profound comatose states induced by apoplexy, opium and other forms of poisoning; and in death by hanging or suffocation. Its occurrence can scarcely be regarded as indicating lesion of any one part of the cerebral centres, but rather as a result of what at present are termed general brain-states. It constitutes a troublesome complication in such chronic forms of brain-disease as general softening, paralysis of the insane, &c.

γ. *From spinal disease.* The relaxation of the sphincter may of course be produced by disease or injury of the lumbar enlargement of the spinal cord. Inasmuch as it is from the cells of this region that the normal tonic influence is understood to emanate, a destruction of the nervous

tissue can readily be understood to prevent the origination of such stimulus to contraction. It is noticeable that changes in the substance of the cord itself, myelitis, &c., are more frequently accompanied by paralysis of the sphincter than is spinal meningitis.

δ. *From local disease.* The control over the sphincter may be lost from injury to the muscle itself, as occurs in laceration of the perinæum, involving the lower end of the bowel.

TREATMENT.—Beyond removal, when possible, of the cause, no direct treatment of incontinence of fæces is of avail. As a distressing complication of certain diseases of the nerve-centres, which are too frequently incurable, little remains to be done for it beyond adopting such measures as will permit of the escape of the discharge with every regard to cleanliness. W. H. ALLCHIN.

FÆCES, Retention of.—ÆTIOLOGY.—In the absence of mechanical obstruction, such as adhesions, bands of false membrane, uterine pressure, stricture, tumours, morbid growths, or hæmorrhoids, the main causes of fæcal accumulation are:—(*a*) a sub-paralysis of the intestinal muscular fibres from defective innervation, or from over-distension of the walls of some portion of the large bowel; (*b*) loss of reflex irritability of the rectum; and (*c*) dryness of the mucous surface of the colon. Hence it is frequently met with in the debilitated, the bedridden, the paralysed, the aged, and the sedentary, and women are more prone to it than men. Loss of reflex sensibility in the rectum is frequently the sole cause. The fæces delivered into the rectum by the contractions of the sigmoid flexure and the descending colon no longer excite the act of defæcation, and collecting there as a large dessicated mass, determine a gradual and painless retention in the colon, and particularly in the most distensible parts—the sigmoid flexure and the cæcum. The accumulation once set up tends also to perpetuate itself by arresting more and more the peristaltic movements, and leading to atrophy of the walls of the bowels.

SYMPTOMS.—Fæces often accumulate slowly and without the knowledge of the patient; hence in cases in which sensibility has been blunted by age, disease, or great debility, the discovery of large collections in the rectum or colon may surprise even the practitioner, who is generally led to a local examination by disturbances set up by the retention. There is usually constipation or an insufficient discharge of solids; a regular and even excessive relief of the bowels does not, however, exclude accumulation, for even fluid fæces may pass through the centre of or over old collections. The evacuations are lumpy, or consist of detached hard, dry, dark scybala, or of a single mass; when the accumulated matters are dislodged by aperients, they often emit an offensive and sour odour. Fæcal collections in the rectum and sigmoid flexure are apt to excite tenesmus and frequent voiding of mucus and blood, but without the putrid flesh-like odour of dysenteric evacuations; and the finger encounters a mass of hardened fæces in the rectum.

An accumulation in the cæcum, or any part of the colon, may be detected through the abdominal wall as a tumour more or less movable and uneven, and doughy to the touch; and in rare cases the large bowel throughout may be so greatly distended as to apparently fill the abdomen with a solid mass which, like other fæcal collections, yields to the firm pressure of the finger. A tympanitic state of the abdomen may, however, so obscure the examination as to prevent the recognition of even moderately large accumulations.

Flatulence, colicky pains, inflammation, (typhlitis, colitis), ulceration and perforation—the cæcum is by far the principal seat of this accident—and intestinal obstruction, are not uncommon results of retention of fæces, concerning which the reader is referred to the articles on CONSTIPATION; CÆCUM, Diseases of; COLON, Diseases of; FLATULENCE; and COLIC.

TREATMENT.—A hard ball of fæces or of agglutinated scybala in the rectum resisting dislodgment by aperients, or enemata, should be broken up and removed, by introducing within the sphincter two or three fingers, a scoop, or the handle of a spoon. This may be facilitated by introducing the fingers within the vagina in the female. Fæcal concretions in this situation, even though not impacted, may require similar mechanical aid; and in consequence of the hardness and size of these bodies the extraction is frequently difficult. When purgatives and injections fail—the former perhaps aggravating the vomiting induced by the obstruction—a long elastic tube should be passed through the indurated mass which resists its progress, and warm olive oil, followed by milk or gruel, should be gradually injected by the stomach-pump or Davidson's syringe; sometimes, however, large injections as ordinarily administered, repeated twice or three times a day, render this proceeding unnecessary. The removal of collections of hard fæces in the rectum may be facilitated by macerating them with suppositories of cacao-butter, or of glue or isinglass softened in cold water, While a brisk aperient, such as a full dose of calomel, or castor oil with croton oil, may afford timely aid, the general medicinal treatment of the accumulation should consist of a prolonged course of gentle, yet efficient evacuants combined with tonics. The gradual collection of fæces, the toneless state of the walls of the large bowel, the scanty secretion of intestinal mucus, and the loss of reflex sensibility in the rectum, require the persevering use of these remedies. A pill containing aloes, belladonna, and nux vomica—to which extract of colchicum is often a useful addition—generally affords the most satisfactory results. When aperients fail to dislodge the fæcal collections, and the abdomen becomes painfully distended, a combination of opium, belladonna, and aloes, given at regular intervals—the dose of aloes, at first small, being increased as the pain diminishes—may enable the bowel to overcome the difficulty; but when there is severe pain, and above all obstinate, and especially stercoraceous vomiting, opium and belladonna should be given alone or with nux vomica until the subsidence of these symptoms, when aloes may be prescribed along with these agents with the best effect. Obstruction from paralysis of a portion of

the bowels in which fæces have accumulated may be met by strychnia, 'restoring capacity of action,' followed by a mild aperient which promotes peristalsis, or by the interrupted galvanic current. Distressing tympanites, which, thwarting the peristaltic movements, intensifies the obstruction, has been overcome by puncture of the cæcum with a fine trochar or aspirator after failure of other means; but this proceeding is not unattended with danger of fatal peritonitis from fæcal extravasation, or from perforative ulceration set up by the punctures, and cannot be safely recommended. GEORGE OLIVER.

FAINTING.—A popular synonym for syncope. *See* SYNCOPE.

FAINTNESS.—Faintness signifies a feeling of great weakness or exhaustion, as if the subject of it were about to become exhausted, or to sink or faint.

FALLING SICKNESS. — A popular synonym for epilepsy. *See* EPILEPSY.

FALLOPIAN TUBES, Diseases of.—The oviducts are liable to the following morbid conditions:—1. Malformations; 2. Displacements; 3. Contractions; 4. Dilatations; 5. Inflammation; 6. New Growths; and, 7. Tubal Pregnancy.

1. **Malformations.**—The Fallopian tubes may be congenitally wanting, either on one or on both sides; or they may be impervious; and, instead of a single opening into the abdominal cavity, there may be two or more.

2. **Displacements.** — The tubes may be stretched or widely displaced from their normal position by growths or effusions in their neighbourhood, such as ovarian, parovarian, &c.

3. **Contractions.**—These canals may be impervious, from inflammation of the lining membrane, or from peritonitis, pressure, or torsion.

4. **Dilatations.**—The Fallopian tubes may be distended, even to a great degree, by (*a*) mucous or serous fluid (*hydro-salpinx*); (*b*) pus (*pyo-salpinx*); or (*c*) blood (*hæmo-salpinx*). In hydro-salpinx the tubes, if much distended, become sacculated, giving rise to a string of cystic tumours. The fluid collects chiefly at the abdominal end of the tube, but occasionally it may escape, and in large quantity, through the uterus. Should the tube burst and discharge its contents into the peritoneal cavity serious results may ensue, especially if the fluid be pus. When hæmo-salpinx is the result of menstrual retention from atresia uteri, bursting of the tubes internally is apt to follow operations for the relief of the obstruction.

5. **Inflammation.**—Inflammation of the Fallopian tubes (*salpingitis*) is apt to be caused by gonorrhœal infection, or it may occur during the puerperal state. Stenosis or *pyo-salpinx* may be the result.

6. **New Growths.**—The Fallopian tubes may be the seat of the following new growths—fibroid tumours, mucous polypi, cysts, cancer and tubercle. Lipomata, involving the integrity of the tubes, may also arise in the adjacent tissues. Fibroids resemble those of the uterus, and may attain a considerable size. Small polypi growing into the canal may partially obstruct the duct. The cysts are usually the so-called *hydatids of Morgagni*, an embryological relic; but other small simple cysts may be met with at the orifice of the tube, around the morsus diaboli. Primary cancer of the tubes rarely, if ever, occurs. Tubercle, however, may be primary, and may occur before puberty. It usually begins at the abdominal end, and may lead to blocking of the tube.

7. **Tubal Pregnancy.**—An important affection of the Fallopian tubes is that arising from the variety of extra-uterine pregnancy called tubal, where the product of conception grows within the tube in some part of its course. This abnormity is apt to be attended with very serious results, bursting of the tube frequently occurring about the third month of gestation; and serious, sometimes fatal, internal hæmorrhage may hence ensue. Tubal gestation usually occurs on one side only, while other affections of the tubes are often symmetrical, a point of diagnostic importance. *See* PREGNANCY, Disorders of.

Regurgitation of blood, of septic matters, and of fluids injected into the uterus, sometimes takes place along the Fallopian tubes, and this accident is always attended by grave consequences.

Mechanical Obstruction of the Fallopian tubes is not an infrequent cause of sterility.

TREATMENT.—The diagnosis of affections of the Fallopian tubes being difficult, their treatment is likewise obscure; and must be in a measure guided by general principles in each case. In pyo-salpinx severe peritonitis and death may result from rupture of the sac, as may speedy dissolution from internal hæmorrhage in tubal gestation. In the former case, and in hydro-salpinx, puncture with the aspirator might be permissible were a clear and unequivocal diagnosis made. In the latter case proximal ligature of the implicated tube might save life, but the diagnosis is surrounded by so many difficulties that such an operation can only rarely be justified.

ALFRED WILTSHIRE.

FALSE MEMBRANE.—An inflammatory exudation of a fibrinous character, which is deposited in layers, chiefly on mucous surfaces, and occasionally on abrasions of the skin. It is well exemplified by the deposit in diphtheria and plastic bronchitis.

FAMILY DISEASES.—Diseases which are found to run in families, or diseases to which members of the same family seem peculiarly liable. *See* DISEASE, Causes of.

FARADISATION, Uses of. *See* ELECTRICITY.

FARCY.—A synonym for glanders. *See* GLANDERS.

FASCIÆ (*fascia*, a band).—The fasciæ are subjects of medical and surgical interest, with respect both to their anatomical relations, to the diseases to which they are liable, and to points of diagnosis in connection with them.

I. **Anatomical Relations of Fasciæ.**—The situation and connections of the fasciæ, according as they are fasciæ of *investment* or fasciæ of *attachment*, are of the greatest practical impor-

tance in the following classes of diseases:—1. Suppuration; 2. Extravasations, and Cellular Emphysema; 3. Herniæ; 4. Dislocations; 5. Diseases of Encapsuled Organs; and, 6. New Growths.

1. Suppuration. — The physical influences exerted by fasciæ upon pus are chiefly two. First, fasciæ may limit the size of an abscess, determine its tension and the many results of the same, and thus affect both the local phenomena and the general symptoms. Secondly, when the pus is not confined, the fasciæ serve to determine the course that it will take and the situation in which it will discharge. Every abscess may be said to be influenced in this way by the relations of fasciæ, but certain fasciæ have to be specially noted as causing pus to burrow, and hence they should be enumerated here:—

a. Fasciæ of the Head and Neck.—The fasciæ of the scalp; the temporal fascia; the cervical fascia; and the post-pharyngeal fascia, which conducts pus from the cervical vertebræ to the parotid region and tonsil, and to the region of the carotid vessels.

b. Fasciæ of the Upper Extremity.—The axillary fascia; and the deep fascia of the upper extremity generally, including the palmar fascia and the sheaths of the tendons.

c. Fasciæ of the Thorax.—The fasciæ of the intercostal spaces and of the mammary region; the fasciæ reaching from the neck to the upper part of the pericardium and the aorta, and to the posterior mediastinum, respectively; the fasciæ of the anterior mediastinum; and the fasciæ connected with the diaphragm—all of which determine the course of intrathoracic abscesses.

d. Fasciæ of the Abdomen and Pelvis.—The transversalis fascia; the fasciæ connected with the transversalis muscle, especially posteriorly, which influence the course of lumbar abscess; the sheaths of the psoas and the iliacus; the pelvic, recto-vesical, obturator and anal fasciæ; the fascial investment of the prostate; the superficial and deep layers of the superficial fascia of the perinæum; the superficial and deep layers of the triangular ligament; and the fascial investments of the rectum, bladder, uterus, and vagina, which determine the course of purulent collections in the pelvis.

e. Fasciæ of the Lower Extremity.—The fascia lata and its processes; the tensor fasciæ femoris; the popliteal fascia; the deep fascia of the leg; and the plantar fascia and its compartments.

2. Extravasations and Cellular Emphysema. —When blood or urine escapes from its natural reservoirs, or when air or gas has found its way amongst the tissues, the direction that the extravasated substance takes is markedly influenced by the fasciæ with which it comes in contact. The principal fasciæ of importance in this respect are as follows:—

a. Fasciæ of the Head and Neck.—The fasciæ of the scalp, and the cervical fascia.

b. Fasciæ of the Thorax.—The fasciæ of the intercostal spaces; and the mediastinal fasciæ, through connections with the cervical.

c. Fasciæ of the Upper Extremity.—The deep fascia in general.

d. Fasciæ of the Abdomen and Pelvis.—Scarpa's fascia, or deep layer of the superficial fascia; both layers of the superficial and of the deep perineal fascia; and the fasciæ of the prostate and bladder—all being of the greatest importance in cases of extravasation of urine or fæces.

e. Fasciæ of the Lower Extremity.—The fascia lata in general; the popliteal fascia; the deep fascia of the leg; and the plantar fascia.

3. Herniæ.—The occurrence of herniæ, and the direction that they take, are in a great measure determined by the condition of the fasciæ in contact with the viscera. Most important in this relation may be mentioned—the fascia transversalis, the iliac fascia, the sheath of the femoral vessels, the obturator fascia, the cribriform fascia, and the fascia lata.

4. Dislocations. — Certain fasciæ serve as supports for the heads of bones, and for the viscera; and these will have an important influence either in promoting or in preventing dislocation, displacement, or other injury of these parts, as the case may be. The shoulder is supported by the costo-coracoid fascia, and this relation considerably affects the signs of dislocation at that joint. In fractures of the patella, the fasciæ of the knee-joint promote separation of the fragments. The fascia of the neck helps to support the pericardium, and must limit the displacements of the heart. The bicipital fascia of the forearm protects the brachial artery beneath it in venesection, at the bend of the elbow. On the other hand, the attachment of the cervical fascia to the jugular veins facilitates the entrance of air into the circulation through a wound at this point. And, lastly, the pelvic viscera are supported by the transversalis, pelvic, iliac, and recto-vesical fasciæ; whilst the cord and testis have their special fasciæ to keep them in position.

5. Diseases of Encapsuled Organs.—A considerable number of organs, many important vessels, and a great variety of muscles are contained in distinct fascial capsules, sheaths, or envelopes, which will affect the course of the diseases of these structures in many ways—defining their limits, or determining the direction in which they spread, and thus influencing both their local and general phenomena. This has been already alluded to under the first head; but it is necessary to enumerate here the principal fasciæ that act in this way, namely:—*a. Arterial sheaths*:—of the carotid, subclavian, thoracic-aortic, and femoral. *b. Muscular sheaths*:—of the masseter, buccinator, psoas, iliacus, quadratus lumborum, erector spinæ, pectineus, rectus abdominis, levator ani, tensor vaginæ femoris, and the palmar and plantar muscles. *c. Visceral capsules*:—of the thyroid gland, parotid and submaxillary glands, tongue, prostate, penis, vagina, bladder, rectum, and mamma.

6. New Growths.—The direction, rapidity, and extent of spread of new growths are considerably modified in certain situations by the relations of the fasciæ above described.

II. **Pathological Relations of Fasciæ.**—The principal diseases of fasciæ are:—1. Inflammation and its results; 2. Ossification; 3. Calcification; 4. Rheumatism; 5. Gout; 6. Syphilis; 7. Contraction; and 8. Extension.—None of these conditions can be said to be common, or of serious importance.

1. Inflammation.—Inflammation involving a fascia is usually secondary, having spread to it from the neighbouring structures, and especially from the muscle or organ of which the fascia may form the sheath. Even under these circumstances, a fascia rather resists than participates in the inflammatory process, as has been described above; and when it is involved it tends to ulcerate on account of its feeble vitality, and to be discharged in the form of sloughs. The healing process is extremely slow in fasciæ, and after serious lesion their function is never completely restored.

2. Ossification.—Occasionally in aged persons portions of fasciæ are found transformed into bony tissue.

3. Calcification.—Calcification is very rare in fasciæ.

4. Rheumatism.—The condition known as muscular rheumatism, or according to its situation as lumbago, torticollis, &c., is believed by some authorities to involve the fibrous coverings or fasciæ of the affected parts. In the same way, many of the aches of some forms of 'chronic rheumatism' may possibly have their seat in fasciæ; and certain cases of neuralgia are probably to be referred to rheumatic inflammation of the nerve-sheath.

5. Gout.—Amongst the pains of the gouty subject are some which are no doubt due to affections of fasciæ, such as pains in the heel and instep, and neuralgia of the sciatic, the anterior crural, and the brachial nerves.

6. Syphilis.—Syphilis may attack the fasciæ in the form of nodes, which in places of low vascularity are apt to ulcerate, as, for example, at the inner aspect of the knee.

7. Contraction.—Contraction is the most obvious of the morbid conditions of fasciæ, giving rise as it does to well-marked deformities. The fasciæ of the hand and foot are most liable to this change, with the result of unnatural flexion of the fingers and toes. Such contraction of the palmar and plantar fasciæ may be due to wounds, burns, or inflammation from any cause, or to gout or rheumatism; it is sometimes congenital; and it sometimes occurs without evident cause.

8. Extension.—A fascia or sheath, though extremely inelastic, is liable to be stretched by swelling of the parts which it envelopes; and, if the cause do not speedily disappear, may remain more or less permanently extended. The best instance of this condition is pendulous abdomen after pregnancy or other form of abdominal enlargement. J. Mitchell Bruce.

FASCIOLA (*fasciola*, a thin band).—A genus of trematode parasites of which the common liver-fluke forms a good type. This entozoon (*F. hepatica*) is characterised by the possession of a branched intestinal canal, thus differing from the flukes belonging to the genus *Distoma*, in which the canal is simple and bifurcated. The liver-fluke is of rare occurrence in man, though extremely abundant in, and destructive to, ruminating animals. *See* Distoma. T. S. Cobbold.

FASTING.—The manifestation of vital activity implies consumption of material; and unless the supply of material in the form of food is equivalent to the loss occurring, a progressive wasting of the body and failure of power must ensue. Hence these phenomena constitute the necessary accompaniments of fasting; and with its prolongation the question resolves itself into one of time—when the exhaustion of material shall have proceeded to such an extent as to render the continuance of life impossible.

Pathology.—To Chossat we are indebted for showing that the immediate cause of death from fasting is a reduction of the bodily temperature. At first there is a gradual, but not very extensive fall. Afterwards a more rapid decline occurs, until the reduction amounts to about 29° or 30° (Fahr.) below the normal point, when death ensues. Chossat noticed that if, whilst in the state of torpor preceding death, the temperature of the animal experimented on was raised by exposure to artificial warmth, a restoration of consciousness and muscular power was induced; and some of his subjects of experiment which were thus rescued from impending death afterwards thoroughly revived on being supplied with food.

Symptoms.—The most prominent symptoms arising from fasting are those due to the special sensations produced by the absence of food and fluid, and those attributable to a decline of the physical and mental power. In the first place there is great uneasiness in the epigastrium. This is followed by a sense of sinking in the same region, accompanied by insatiable thirst; and if fluid be persistently withheld as well as food, the thirst becomes the chief source of distress. The countenance assumes a pale and cadaverous appearance, and a look of wildness is presented about the eyes. Emaciation becomes more and more marked, and with it there is a decline of the bodily strength. There is also failure of the mental power. Stupidity may advance to imbecility; and a state of maniacal delirium frequently supervenes. Life terminates either calmly by gradually increasing torpidity, or, it may be, suddenly in a convulsive paroxysm.

Duration of Life.—The usual duration of life under complete absence of food and drink may be said to be from eight to ten days. The special circumstances, however, existing may exert a modifying influence, and from the nature of these the period may be either diminished or increased. A stout person, as may be readily understood, has a chance of living longer than a thin one, on account of the store of combustible material which may be drawn upon being larger. Exposure to cold in conjunction with starvation very much hastens death. The presence of moisture in the atmosphere favours the prolongation of life, by diminishing the exhalation of fluid from the body. It may be assumed to be owing to the existence of warmth and moisture that persons buried in mines, or otherwise similarly placed, have been known to live considerably beyond the ordinary period.

The Welsh fasting girl, about whom so much excitement was created in 1869, lived exactly eight days from the time she was placed under systematic inspection to solve the problem of whether she could exist, as had been alleged by her parents, for an indefinite period without food!

It appears that during the first part of the time she was cheerful and exhibited nothing extraordinary. Later on it was found that she could not be kept warm, and ultimately she sank into a state of torpor, from which she could not be roused and which speedily terminated in death.

In the Troedyrhiw colliery near Pontypridd an inundation occurred in 1877, which led to the imprisonment of four men and a boy in one of the headings of the mine. The accident happened on Wednesday evening, the 11th of April. Efforts were at once made, by means of a cutting, to reach the chamber in which the imprisoned persons were confined, and to release them. This was not accomplished till the afternoon of Thursday, the 19th, when all were rescued alive and did well. They had been imprisoned in an atmosphere of compressed air nearly eight days, without food but within reach of water. The more recent case of Dr. Tanner throws no new light upon the subject.

Treatment.—Caution is required in the administration of food after prolonged fasting. Sudden transitions of all kinds are trying to the body; and, instead of allowing the rescued sufferer to gratify his desire to eat and drink according to his inclination after several days' abstinence, the supply of both food and drink should at first be limited, and afterwards gradually increased. There is reason to believe that the non-observance of this rule has upon some occasions been followed by disastrous consequences which a different plan might have averted. F. W. Pavy.

FAT.—Fat becomes a disease under the following circumstances:—

1. As **Obesity.**—Fat may be found generally diffused in excessive quantity beneath the skin, beneath serous membranes, and in and upon the various tissues and organs of the body. This condition constitutes what is known as Obesity. The subject will be found fully discussed under that head.

As a **Partial Growth** of fat, which sometimes occurs in paralysed muscles, and constitutes a characteristic feature of what is called pseudo-muscular hypertrophy. *See* Pseudo-Hypertrophic Paralysis.

2. As **Fatty Interstitial Growths.**—Fat as fat-tissue becomes more especially a disease when it is deposited upon and in the textures of organs, interfering with their structure and functions. It does this by pressing upon the elements of the organ invaded; and its effects are more particularly seen when it invades the muscular tissue of such an organ as the heart, the fibres of which, becoming more or less atrophied and distorted in their course and direction, are rendered inadequate for the performance of their functions. *See* Heart, Fatty Diseases of.

3. As **Fatty Tumours.**—Fat may also occur in isolated or circumscribed masses, constituting what are known as *Fatty Tumours* or *Lipomata*. *See* Tumours.

4. As **Fatty Infiltration.**—Fat in the form of oily particles is found to be present in excess in the cells of various secreting organs, constituting fatty infiltration. Thus it appears in the epithelium of the intestinal mucous membrane during digestion; in the cells of the liver and biliary passages; and in the kidneys of certain animals—for instance, the cat. When this condition becomes permanent it must be considered as a disease. Glandular organs thus affected, as in the case of the liver, assume a buff or yellow colour, and become softer and more friable than normal; while microscopically their cells are found to contain one or more large well-defined oil-globules, which tend to coalesce and occupy the cell. The quantity of oily matter in the cells may, however, vary from time to time, and the infiltration may be either of a transient or of a permanent character. In the one case, the function of the organ may not be materially interfered with; in the other case, the activity of the cells may be so far affected as greatly to impair the secreting functions of the organ.

The causes of fatty infiltration are of two kinds—general and local. First, the *general* causes are (1) a superabundance of fatty matters in the blood, as occurs in persons who indulge in rich food and in beverages containing alcohol; (2) imperfect oxidation, as in chronic tuberculosis of the lungs; and (3), according to some observers, the metastasis of fatty deposits from one part of the body to another.

Secondly, with respect to the *local* causes of fatty infiltration, one is a peculiar affinity or selective power of the cells of certain tissues, by virtue of which they incorporate with their substance oily or fatty matter. This facility has been explained in the case of the cells of the liver and of the passages traversed by bile, by the presence of that fluid, which, as Virchow and others describe, is a powerfully determining cause of the infiltration of fat into protoplasm. Another local cause of the accumulation of oil in cells is their inactivity or imperfect power of eliminating it, as is found to occur in the cartilages of the aged, and in inactive muscles.

It must be said here, with respect to the appearance of fat in the last-named situations that though, in some cases, it is derived unquestionably from the fat contained in the blood or chyle, it may in other instances be derived from the disintegration of the protein elements of the tissues. This subject, however, will be found discussed in the article upon Fatty Degeneration. R. Quain, M.D.

FATIGUE (*fatigo*, I weary).

General Remarks.—Fatigue is a regular and constantly returning symptom experienced by all persons. Periods of functional activity invariably alternate with periods of repose during which the waste caused by the exercise of function is repaired. We are indebted to Sir James Paget for having pointed out that 'rhythmic nutrition is a law of nature,' and although the truth of this dogma is recognised on all hands, and may be said to be axiomatic, it has hardly received that careful consideration at the hands of practical physicians which it deserves. Our whole life is composed of a series of vibrations—periods of tension alternating with periods of relaxation; and although the rapidity of these vibrations varies immensely, they are recognisable in all our acts, whether voluntary or otherwise. The vibrations of the heart are about seventy in a

minute, those of the respiratory organs about sixteen. The whole body requires a certain period of absolute and continuous repose in each twenty-four hours (amounting to nearly one-third of the period), so that we may say its rate of vibration is once in the twenty-four hours. In like manner the period of relaxation of the heart is about one-third of the total period of a revolution, and this proportional correspondence between a local and a general condition is not a little interesting and suggestive. Again it is universally ordained amongst civilised nations that once in every seven days there shall be a remission of labour and a change of occupation; and we recognise the fact that it is highly advisable for those who are occupied in one pursuit to break away from it at least once a year and indulge in that variety of work which we call amusement.

Fatigue occurs directly we attempt to alter the rhythm of our vital vibrations by prolonging the periods of tension at the expense of the period of relaxation, or by demanding for any length of time a quickening of the normal rate of vibration. We recognise the fact that athletes who over-train run risks of cardiac troubles and loss of wind; that the man who from any cause is unable to sleep runs a serious risk of permanent impairment of health; and when we find patients pursuing their avocations too zealously we know that, if such offence against the laws of nature be persisted in, general paralysis, or other forms of 'break-down,' are likely to be the result.

Fatigue may be *general* or *local*, and both forms may be either acute or chronic. That fatigue in all its forms is due to impaired nutrition there can be little doubt, and we shall find that the symptoms of chronic fatigue are often the prelude of definite and recognisable degenerative changes.

Description.—**General Fatigue.**—General fatigue is recognised with ease both in its acute and chronic forms. There is a disability to perform either mental or physical work, and this disability is noticed first in work requiring attention or sustained effort, and last in those acts which have become automatic or secondarily automatic. The symptoms of general fatigue are usually referable to the nervous centres.

Local Fatigue.—Local fatigue is either acute or chronic, and the symptoms of it are referable usually to the muscles; but we must always bear in mind that muscle and motor-nerve are practically one and indivisible, and that recent experiments have given great probability to the idea that every muscle is connected with a certain definite spot in the brain. When, therefore, we speak of a sense of fatigue, we must necessarily be in doubt, notwithstanding the fact that the symptoms are apparently located in the muscles, whether the brain, nerve, or muscle, one or all of them, be really at fault.

Acute local fatigue.—The symptoms of acute local fatigue are, first, loss of power to a greater or less extent. By too frequent or too prolonged stimulation the irritability of the muscular tissue becomes exhausted, and it either refuses to respond, or responds but feebly to the stimulus of the will; whilst our power of adjusting the force of contraction to the act to be accomplished is lessened, and accuracy of movement and delicacy of co-ordination are destroyed. The second symptom of acute fatigue is tremor, as everyone must have experienced who has been called upon for any unusual exertion. The third symptom is cramp-like contraction; and the fourth is pain, the pain being the pain of fatigue and absolutely distinct from other varieties of pain. Fatigue is caused far sooner by prolonged muscular effort than by repetitions of short muscular efforts having due intervals of relaxation between them. Anyone who has attempted to hold out a weight at arm's length knows the impossibility of continuing the effort for any length of time; and it is proverbially true that standing in one position is, to most people, far more tiring than walking, the reason being that in standing the muscles which support the body are subjected to a prolonged strain while in walking we use the muscles on either side of the body alternately. The great increase of power which we obtain by using the muscles on either side of the body alternatively would seem to be one of the chief reasons for the bilateral symmetry of the body. Not only is sustained effort a far more potent cause of fatigue than repeated effort, but we find that when fatigue supervenes, actions requiring sustained effort are the first to fail, and in this local fatigue resembles general fatigue. The last acts to be affected by fatigue are such as are automatic, and are accomplished without mental effort, and by the expenditure of the least possible amount of force. It is quite possible to exhaust a muscle by artificial stimulation, and if one of the small interossei muscles be continuously faradised, it will be found that in a very short time its power of contraction to any form of stimulus may be absolutely abolished. It is tolerably certain that the brain can have no share in artificial fatigue thus produced, and there seems good reason to suppose that, in some people of energetic temperament, the irritability of a muscle may be exhausted, while the power of mental stimulation remains almost unimpaired.

Chronic local fatigue.—This form of fatigue has causes and symptoms similar to those of acute local fatigue, and there can be little doubt that this condition is a common cause of many of those chronic maladies which seem to result from overwork, and are characterised by irregular muscular action. That some cases of writer's cramp (*see* Writer's Cramp) are due to chronic fatigue of certain muscles employed in writing, and particularly of those subjected to prolonged effort, there can be little doubt. Some cases of torticollis seem due to the same cause. Duchenne and Brudenell-Carter have pointed out how, in cases of 'short sight,' the strain on the internal recti has caused troubles of vision, and even brain-symptoms, and quite lately Mr. C. B Taylor, of Nottingham, has shown reason for including in the category of fatigue-diseases a peculiar form of nystagmus, occurring amongst miners, who try their eyes by working in the dark.

Treatment.—The treatment of fatigue in all its forms is *rest*, and the restoration of the proper rhythm of nutrition, if this be found perverted, by substituting rhythmical exercises for unrhythmical efforts. G. V. Poore.

FATTY DEGENERATION.—Synon. Fr. *Dégénérescence graisseuse*; Ger. *Fettige Metamorphose.*

Definition.—The process by which protein elements are converted into a granular fatty matter.

Seats of Occurrence.—This change may occur in any of the component elements of the body, whether normal or abnormal.

Physiologically. The production of milk from the protoplasm of the mammary cells, and of sebum from the cells of the sebaceous glands, are instances of fatty degeneration. The cells of the corpus luteum are partly in a condition of fatty degeneration; and it is by a similar change in the peripheral cells of the mature fœtal portion of the placenta that normal involution of hat organ is accomplished. Non-vascular structures, such as the cartilages, the cornea, and the intima of blood-vessels, frequently undergo fatty transformation of part of their substance. In a less marked form, fatty degeneration occurs in the walls of the uterus and other muscular organs when returning to their ordinary size after temporary hypertrophy.

Pathologically. As a purely morbid process, fatty change is most frequently met with in the muscular tissue of the heart, in the walls of capillaries, and in the urinary tubules; but it also occurs in the central nervous system, constituting the condition known as 'white softening'; in the liver; and in tubercular deposits, cancerous growths, infarcts, and inflammatory products in any situation whatever.

Anatomical Characters.—*Physical Characters.*—An organ that has undergone fatty degeneration presents the following physical characters. The bulk and weight are generally increased; the consistence is reduced, sometimes to a pulp, as in white softening of the brain; the colour is changed, either as a whole or in the affected portions of the organ, into a buffy or yellowish bloodless hue; and the resistance or firmness is diminished, so that the affected tissue is markedly flabby, and readily yields to pressure. The solid cut surface may appear compact and shining; and the section leaves a greasy stain upon the knife and fingers. When fatty degeneration is greatly advanced, as it may be seen, for example, in the liver, a portion of the organ thrown into water will float.

Microscopical Characters.—In fatty degeneration the muscular tissue of the heart and the walls of capillaries are most suitable for microscopical investigation. The earliest changes in the *cardiac muscle* in fatty degeneration are loss of sharpness of the individual striæ and the appearance of minute particles of oil between the elements. These changes, beginning near the nuclei, spread throughout the fibres in a longitudinal direction, while the particles increase in size and assume the well-known characters of oil-globules. When the process is advanced, the whole of the sarcous substance is replaced by fatty particles contained within a delicate albuminous envelope. Finally the degenerated fibres either become atrophied by absorption of certain parts of the fat, and so disappear; or suffer rupture with discharge of their contents. The fatty nature of the change is proved by the solubility in ether of the particles that have escaped from the fibres.

Fatty degeneration of the *walls of vessels* is best seen in the capillaries and smallest arteries. The tunics first lose their normal translucency; minute granules appear in their substance; and these increase to form unmistakable oil-globules. Finally the vessel gives way, and the oily particles and blood are discharged into the perivascular space.

In the other organs referred to, the microscopical characters agree with those just described, with certain differences dependent upon the special structure of each. Thus fatty degeneration of a leucocyte leads to the formation of the body known as a *compound granular corpuscle*, in which the oil-drops finally replace the whole of the protoplasm. In 'white softening' of nervous tissue, the nerve-cells and probably all the nuclei of the part are converted in a great measure into granular corpuscles; and these breaking down into a fatty detritus, the whole constitutes a soft creamy-looking substance, which, as Virchow expresses it, 'is milk in the brain, instead of in the mammary gland.' 'Yellow tubercle' consists in part of cells and nuclei that have undergone fatty degeneration, and of fatty detritus. In the case of the uterus during involution the fat is probably rapidly absorbed, so that the appearances presented to the eye are those rather of atrophy than of replacement of the muscular substance by fat.

Pathology.—We have now to trace whence comes the fat that is found in this form of degeneration, and how. It is evident that in a number of instances—such as the production of milk and sebum—fatty degeneration is a truly physiological change, which is subservient to health when active, while its derangement or cessation constitutes disease. In other cases the process is essentially pathological, as, for example, in fatty degeneration of the heart and white softening of the brain; the functional activity of the part being impaired, or so abolished that the name of *necrobiosis*, or death-in-life, has been given to the condition. The fatty change in the two instances is, however, manifestly one and the same. The condition known as fatty degeneration had long been described, and it has always been a favourite subject with pathologists to discover its nature and its cause. It was generally assumed that the fatty matter present was introduced from without, being deposited from the blood as morbid material in place of the pre-existing tissues which were absorbed. Modern research has demonstrated that this is not so, and that fat is derived from a molecular change in the tissue or textures in which it is found. The subject is one of immense importance, involving the whole field of pathology; and it is but right to state that our acquaintance with the true nature of the process, is almost entirely due to the investigations of Dr. Quain, which were published in the *Medico-Chirurgical Transactions* for 1850, and with reference to which Sir James Paget has remarked:—'Dr. Quain has candidly referred to many previous observers by whom similar changes were recognised; but the honour of the full proof, and of the right use of it, belongs to himself alone.'—*Lectures on Surgical Pathology*, 1st ed. vol. i. p. 107, *note*. Dr. Quain's conclusion was that the molecular fatty

matter in the degenerated fibre was the result of a chemical or physical change in the composition of the tissue, occurring independently of those processes which we call vital. The arguments which he adduced in support of this view were the following:—(1) That in the formation of the substance known as adipocere from albuminous material after death, the places of the muscular fibres, blood-vessels, and nerves are occupied by fatty matter which could not have existed in them as such during life. (2) That a true fatty degeneration may be artificially produced *post mortem*. (3) That masses of albuminous material deprived of nutrition in any part of the body, or the centre of non-vascular structures such as tubercle, undergo fatty degeneration to a marked degree. (4) That the circumstances under which fatty degeneration occurs in the living body exhibit impairment of general and local nutrition, such as blood-disorder, or disease of the nutrient vessels. More than twenty years later (1871), Dr. Quain's conclusions respecting the nature of fatty degeneration were experimentally confirmed in the living animal by the investigations of Bauer and Voit, of Munich. On administering phosphorus to a starving dog, in which the amount of nitrogen (urea) daily excreted had become constant, these experimenters found that the amount of the excretion was thereby increased threefold; that this nitrogen was derived from the albumen of the tissues and not of the blood; and at the same time that three times the normal amount of oil had accumulated in the viscera. This oil could have its origin only in the transformed or decomposed albumen of the organism; the other product being the urea which had been excreted. The same results have been observed in poisoning by phosphorus in the human body.

Many other instances of the formation of a fatty from a nitrogenous body might be adduced if necessary, such as the ripening of cheese; the increased flow of milk on a meat diet; the formation of wax by bees from sugar and albumen; the production of fatty acids and their allies from proteid compounds in the process of pancreatic digestion; the increase of oil in olives by keeping; and the development of a rancid oil in the flake of salmon under similar circumstances. The numerous instances just adduced combine to strengthen the position—which was, however, sufficiently established by Dr. Quain—that in true fatty degeneration, the nitrogenous material of the tissues themselves, and not the blood, must be considered the source of the oily matter. It has been said that the circumstances under which fatty degeneration occurs are further confirmatory evidence in the same direction. These must now be considered.

Conditions of Occurrence.—The circumstances under which fatty degeneration occurs are either such as affect the nutrition of the whole system generally, or of a given organ, or portion of it, specially.

General.—When the amount of blood in the body is quickly reduced, for example, by severe but not actually sudden hæmorrhage, death may occur from fatty degeneration of the heart, the voluntary muscles and the other viscera being likewise, but less seriously, affected. Again, general fatty degeneration is frequently due to depraved quality of blood, and especially to the presence in it of certain poisons, such as phosphorus, arsenic, antimony, and the more complex animal-poisons of the acute specific fevers.

Local.—Disease of the nutrient artery of a part is the morbid condition most frequently associated with localised fatty degeneration. A good instance of this is furnished by fatty degeneration of patches of the muscular tissue of the heart corresponding with degeneration, obstruction, or compression of a branch of a coronary artery. Another excellent example of the same is white softening of the brain from vascular degeneration. This is analogous to what occurs in dry gangrene, with the exception that decomposition takes place in the latter, probably from the admission of air.

Summary.—When we review the circumstances under which fatty degeneration is found to occur, we discover that the condition that is common to them all is interference with nutrition, and especially with the process of oxidation. The red corpuscles are believed to be primarily affected in phosphorus-poisoning; they are numerically reduced in continued hæmorrhage; and they do not reach the tissues in sufficient numbers when the vessels are obstructed, or otherwise diseased. In the cases of the hypertrophied uterus and heart, of the placenta, and probably of the corpus luteum, the degeneration is probably due to the decline or cessation of functional activity, and the consequent decrease in the blood-supply to the large mass of protoplasmic structures.

With respect to the *intimate* or *essential nature* of fatty degeneration, it may be stated as highly probable, as far as our present knowledge extends, that the metabolism or decomposition that is constantly going on in living protoplasm is not simple or immediate; but that a primary decomposition occurs of albuminous substances into urea (or its allies) and fat, and a further or secondary decomposition of the fat into carbonic acid and water. If the amount of oxygen furnished by the blood is deficient, whether absolutely or relatively, the primary decomposition of the protoplasm alone may be effected; and the secondary decomposition, or the oxidation of fat into carbonic acid and water, may not occur. The result therefore of an absolute or relative deficiency of oxygen in protoplasmic tissues will be the accumulation of fat within them.

Effects.—The physical effects of fatty degeneration of a tissue have been already described under the head of physical characters, being chiefly—change of colour, diminished consistence and resisting power, softening, rupture, dilatation and excavation, and alteration of size. The chief physiological effect is diminished functional power or activity, which is especially marked in muscular parts such as the heart, and in the kidneys.

Treatment.—The subject of the treatment of fatty degeneration will be found discussed under the head of the diseases of the several organs which it may affect. J. Mitchell Bruce.

FATUITY (*fatuus*, silly).—Mental imbecility. *See* Imbecility.

FAUCES, Diseases of. *See* THROAT, Diseases of.

FAVUS (*favus*, a honeycomb).—SYNON.: *Tinea favosa*; Fr. *Favus*; Ger. *Wachsgrind.*

ÆTIOLOGY.—Favus is very uncommon in England; it is more frequently seen in Scotland and abroad. It usually attacks the scalp, rarely the body, of young children amongst the poorer members of the community. It may be contracted from certain animals, especially mice.

ANATOMICAL CHARACTERS.—If the favi be examined microscopically—that is, if small portions be placed in potash and put under the microscope—they are seen to be made up entirely of fungus. The fungus by its growth irritates the scalp, and making its way down the hair-follicles, it finds access to the hair-shafts, which are swollen, altered in texture, and loaded with fungus-elements, whilst the hair-forming apparatus becomes more or less destroyed and the hair falls. The fungus (*achorion Schönleinii*) consists of oval, nucleated conidia, $\frac{1}{3500}$ inch in diameter, free, jointed or constricted; large branching or tortuous mycelial filaments, $\frac{1}{8000}$ inch or so in diameter, filled with granules and spores; and stroma made up of minute cellular elements.

DESCRIPTION.—The characteristic feature of the disease is the development of light sulphur-coloured, circular, cupped crusts, called *favi*, penetrated by the hairs in their centres. At first a minute opaque spot is visible beneath the epidermis, and this gradually enlarges into a *favus*. These favi are about the size of a split-pea, or larger, varying, in fact, from $\frac{1}{25}$ to $\frac{3}{8}$ of an inch in diameter, and $\frac{1}{25}$ to $\frac{1}{6}$ of an inch in depth. They lie or are imbedded in a depression of the derma, and are convex therefore on their under aspect, but concave above, and the surface has a stratified appearance. These favi may be discrete or crowd together into an irregular mass, in which the distinctness of the several favi is more or less lost. In severe cases redness, soreness, tumefaction of the scalp, and baldness result.

DIAGNOSIS.—Favus may be mistaken for impetigo at first sight, but only by a careless observer, because characteristic favi are always present.

TREATMENT.—The treatment is both disappointing and tedious. The patient must be placed under the best hygienic régime; his nutrition must be improved by good living, and the exhibition of cod-liver oil, steel, and quinine; the favi must be removed by poulticing; and parasiticides must be continuously applied, in conjunction with the practice of epilation. At first sulphurous acid lotion (one part to three or four of water) may be continuously soaked-in for some time; and this may be followed by the infriction of iodide of sulphur ointment, double strength, if it can be borne, to which is added oil of cade in the proportion of two drachms of the latter to an ounce of the former.

TILBURY FOX.

FEBRICULA (*febricula*, slight fever).—SYNON.: Fr. *Fébricule*; Ger. *Febricula.*

DEFINITION.—Simple fever, of one (*Ephemera*) or not more than a few days' duration; not preceded by any one known invariable antecedent; and not attended by any one definite organic lesion.

It may well be doubted, however, whether such a thing as simple fever, in the strict sense of the term, exists; anyhow it must be one of the rarer forms of disease. The conditions which, from our necessarily imperfect knowledge, it is convenient to call Febricula are numerous and of great practical importance. They may be somewhat roughly grouped as follows:—

1. Abortive or incomplete forms of some one or other of the specific continued fevers, namely, typhus, typhoid, or relapsing. The writer's own experience leaves no doubt in his mind that such irregular forms are met with during epidemics of those diseases.

2. Instances of some of the exanthemata, especially scarlatina and modified variola, in which the usual rash is either absent or so slight or brief as to pass unnoticed.

3. Intermittent fevers in which for some reason or other the paroxysms do not recur, or only at uncertain and distant intervals.

4. Cases in which the local symptoms usually attending certain forms of fever are very slight or very obscure, and therefore difficult, perhaps impossible, to detect. Instances of this occur in connection with tonsillitis, erysipelas, rheumatic fever, and tubercular disease.

5. Cases in which considerable febrile movement is present during the development of the primary as well as of the secondary symptoms of syphilis, and of which it is not easy to ascertain the real cause.

6. Fever as the consequence of exposure to a high external temperature, for instance, the *febris ardens* of tropical climates (Murchison); and of violent and prolonged muscular exertion.

7. Fever as the consequence of irritation of any organ or tissue, such as the stomach by indigestible matter, of the colon by scybala; or of catarrh of a mucous surface, for example, urethral fever.

8. Certain ill-understood but not uncommon disorders of nervous centres, cerebral, spinal, or sympathetic, are often followed by febrile movement.

ANATOMICAL CHARACTERS.—Fever, however caused, which runs high produces congestions and tissue-changes in the viscera, especially in the lungs; but, in view of the short duration of febricula, it would in most cases be impossible to decide whether any pathological change found after death were the consequence or the cause of the febrile movement. It is possible, but not yet proved, that there may exist some contagion capable of producing febricula, and febricula only.

SYMPTOMS.—Febricula is characterised by a rise of temperature, rarely exceeding 102·5° F., but sometimes, especially in cases due to exposure, reaching 105° F. or even higher, although only for a short time. The access of fever may be gradual, or marked by slight rigors; and some or all of the common clinical symptoms of fever may be present in varying proportion and in greater or less degree, such as general malaise; dry skin; frequent pulse, amounting to 100 or 120 per minute; tongue furred and with a more or less distinct central dry reddish-brown streak; thirst, loss of appetite, and nausea; constipation; scanty high-coloured urine;

and headache, intolerance of light, slight deafness, restlessness, sleeplessness, and slight delirium at night.

Diagnosis.—The diagnosis of febricula rests upon the exclusion of all the other recognised kinds of idiopathic or of symptomatic fever. As a matter of practical diagnosis at the bedside, almost every disease attended by rise of temperature is now and then, at its outset, mistaken for febricula.

Prognosis.—The prognosis depends upon the degree and duration of the pyrexia, but in this country is almost always favourable.

Treatment.—In the absence of any special indication, rest in bed for a day or two, liquid food until the desire for solids returns, and, if constipation be a marked feature of the case, a moderate dose of some mild purgative, will be sufficient. It is, however, always prudent to remember that what seems to be febricula may be the beginning of some serious and perhaps highly infectious disease. Cooling drinks such as Citrate of Potash in effervescence, Liquor Ammoniæ Acetatis with a little Spirit of Æther; or Nitro-hydrochloric or Dilute Nitric Acid (one drachm to a pint of water) with some fresh lemon-juice added, may be given according as the one or the other is grateful to the patient. Anything like active treatment, except the use of the cold or tepid bath in cases of heat-fever, is unnecessary, rarely does good, and is almost always positively injurious. J. Andrew.

FEBRIFUGES (*febris*, a fever, and *fugo*, I drive away). Synon.: Antipyretics.

Definition.—External applications or internal remedies which tend to lower the bodily temperature when it has been abnormally raised by the processes of fever.

Enumeration.—The principal febrifuges, given in the order of their activity, are: Cold Baths; Cold Affusion or Wet Pack; Alcohol, and Diaphoretics; Salicylic Acid, Quinine, Digitalis, and Aconite; Trimethylamine; Iron; and Water and Diluents generally.

Action.—Following Professor Binz, we may divide febrifuges into two classes:—1. those which directly withdraw heat from the fevered organism; and, 2. those which lessen its production.

1. In the first division we must give the foremost place to cold baths, which powerfully abstract caloric from the surface of the body and rapidly cool down the blood. Diaphoretics and alcohol act more feebly in the same direction, by dilating the cutaneous arterioles, and thus allowing the mass of the circulating fluid to be effectually exposed to the chilling influence of the air. *See* Cold, Therapeutics of; and Diaphoretics.

2. Secondly, we have to consider those drugs which actually check the febrile condition itself, and our explanation of their effects must naturally depend on the views held regarding the intimate nature of fever. If we believe in an overborne or paralysed condition of the nervous system as any essential factor, or if we look upon the vascular structures as primarily at fault, then we must shape our theories accordingly; but if we believe, with our best authorities, that the true explanation must be looked for in the introduction of extraneous ferments or septic material into the blood, the matter is much simplified. Quinine and salicylic acid then merely act in virtue of their antiseptic power over protoplasm; and if malaria really depends on the fermenting influence of vegetable germs from decaying vegetation, then the so-called specific action of quinine is readily explained. Again, temperature may be lowered by checking the oxidation of the tissues, and interfering with the oxygenating function of the hæmoglobin, and alcohol is said more particularly to act by lessening the activity of secreting cells. The free use of water tends to promote excretion, and thus to remove the products of oxidation.

Uses.—Antipyretic treatment is not adopted in this country as a matter of routine, holding as we do that temperatures raised within certain limits are not *per se* elements of danger, and that even although we may effectually cool down our patient, the progress of the disease may go on quite unchecked. But when the thermometer registers 105°, and still tends upwards, we know that dangerous limits are reached, and that as a rule life is not long sustained after 107°. It then becomes our duty to interfere, and this is best done by plunging our patient into a bath at 95°, and gradually cooling it down to 65°. When the temperature goes down to within 4° or 5° of the normal we remove him to bed, remembering the dilatation of vessels which must follow the contracting effect of cold, and the consequent cooling process which must continue to go on. Here, as in all febrile conditions, the thermometer is our surest guide, and we must be directed by it as to when to resume the treatment, for frequent repetition may be needed, and on the Continent as many as 200 baths have been given in the course of a single illness. Along with this the Germans combine the use of large doses of quinine; but notwithstanding the marked tolerance of the drug under pyrexial conditions, the danger of perilous depression from such free medication is no imaginary one; and, putting ague apart, we find this valuable drug most beneficial in such fevers as seem to owe their origin to septic poisoning. Digitalis is not a powerful antipyretic, and in large doses is too depressing to the heart, and too apt to produce gastric derangement, to inspire much confidence; while veratria seems simply to act by throwing the patient into a form of collapse. The influence of salicylic acid over acute rheumatism is remarkable, as it seldom fails to reduce temperature and relieve pain in forty-eight hours, but in other feverish conditions its beneficial action is by no means so well marked. Iron is of value in erysipelas, and exerts some controlling power over acute rheumatism. Aconite and diaphoretics are of undoubted service in aiding the defervescence of some of the minor febrile disorders. R. Farquharson.

FEBRIS (Latin). *See* Fever.

FEIGNED DISEASES.—No insignificant part of the real difficulty in the practice of our profession depends on what we may call feigned diseases. The art of diagnosis consists in the power of recognising morbid conditions with skill and promptitude; and in proportion to the natural sharpness and well-digested experience

of the medical man, is his success in the discrimination of one symptom from another which resembles it more or less superficially. Many disorders possess a strong family likeness in their very early stages, whilst others may prove deceptive throughout their whole career, and if to this we add the efforts at deception occasionally resorted to by impostors, we see the caution which must of necessity be adopted by those who exercise their calling within wide limits. In considering, therefore, the subject of Feigned Diseases a greater amount of order may attend our studies if we adopt the following simple classification:—

1. Those diseases which naturally resemble one another, and in the deception attending the diagnosis of which the patient has no share.

2. Those diseases which are also difficult of diagnosis, but in which the patient involuntarily deceives under some morbid nervous impulse.

3. Cases in which the patient sets himself deliberately and elaborately to deceive those around him.

1. Under this heading we may perhaps include the exanthemata and other acute feverish affections, which are confessedly difficult of diagnosis before the eruption or other marked points of difference are fully established. Important though it may be, in the case of public schools or large bodies of men, to act promptly in the face of such an emergency, the medical man will often feel himself compelled to postpone his decision, but he should at the same time act on the defensive by the timely exercise of quarantine and hygienic precautions. Some diseases, again, are difficult to distinguish from one another, even after their prodromata have passed away, and among these we may include small-pox and pustular syphilis, which occasionally in our own experience have caused more than a shade of suspicion to pass over the mind; whilst mild variola and severe varicella must always have too many points in common, to render them otherwise than stumbling-blocks even to the initiated. Various forms of roseola may closely simulate measles; scabies is often hardly to be picked out from amongst the eruptions which its irritation causes; whilst throat-affections may apparently overlap each other and engender the idea of diphtheria where nothing more than superficial or aphthous ulceration really exists. But it is when the ailment under which our patient labours resembles something else during its whole career, that mistakes are naturally most likely to arise. We are frequently shocked with some scandal in which the innocent victim of brain- or other organic disease has been consigned to a police-cell, and where the plea of drunkenness has been attempted to be sustained by the guardians of the public peace. So difficult is it to make a really trustworthy diagnosis between the coma of alcohol, of uræmia, of opium, and of certain apoplectic conditions, that the really cautious and well-informed practitioner would prefer not to attempt to do so offhand. It is impossible to lay down any general rules, but we may remember that alcohol in poisonous doses lowers the temperature and dilates the pupil; that in uræmia an examination of the urine will put us in the right track; whereas opium will produce a contracted pupil; and in cerebral hæmorrhage some elevation of the body-heat may not improbably be observed.

But all these points may fail us from time to time, and we had best act at all times as though the case were really a serious one, and worthy of being treated by all the best resources of the medical art.

A very little consideration will enable every experienced practitioner to recall other instances of this sort of natural mimicry; of the difficulty he must often experience in deciding between syphilitic and other brain-affections; of the close affinity between pulmonary consumption and dilatation of the bronchial tubes; of the resemblance between specific and malignant ulcerations; between various diseases of the testicle, the bladder, and the stomach, respectively. All these form part of the regular teaching of medicine and surgery, and will be treated of at greater or less length elsewhere.

2. We must now consider the cases in which diseases are feigned not by the direct action of the patient himself, but because he is unable to resist the vagaries of his weak and excitable nervous system.

Problems of the greatest complexity and difficulty are here presented to the medical man and require for their due solution much tact and experience. Functional affections so closely simulate organic disease under these circumstances that suspicion is often completely disarmed, and treatment adopted the very opposite of that which would most probably prove curative. Hysteria, in its protean forms, supplies the greater number of these cases, and may very closely simulate a large variety, more especially of neurotic conditions. Paraplegia, incontinence of urine, joint-affections—in short, almost any disease which does not admit of palpable objective demonstration—may thus be feigned, and very severe treatment may even be adopted under the belief that real organic changes have to be met by the usually appropriate remedies. It is only necessary for us to refer thus briefly to these perplexing cases here; but it must always remain an interesting problem as to how the mechanism of causation here works, so to speak, and whether the patient actually suffers the acute pain of which she complains so forcibly. Sympathy, as we well know, however, is quite thrown away when dealing with these persons; and apparent roughness, with nervine tonics, and mental discipline, will often effect a cure, when the most elaborate combinations of other drugs ignominiously fail. A sudden shock, the pressure of poverty, or the absolute necessity for immediate exertion, will often effectually and permanently arouse the bedridden hypochondriac of many years, and restore him to his friends as a useful member of society, and we need never despair of success even under apparently hopeless circumstances. And although in minor measure the hypochondriac may fancy that every organ in succession is the seat of disease and may even succeed in thus imposing on the unwary, the experienced practitioner will speedily detect the fiction and be able to relieve the unhappy sufferer from the weight of his woes.

But let it not be forgotten that 'expectant

attention,' or the constant direction of the mind to the supposed morbid condition of any particular organ, may actually catch the unconscious deceiver in his own net by converting mere functional disturbance into organic disease.

3. To the third division of our subject the term Feigned Diseases can perhaps alone strictly be applied. Here we are met face to face with deliberate and premeditated imposture, and there is nothing for it but to match our own wits against those of the deceiver, and to thwart his native cunning by the superior sharpness of science. Now, there is nothing in the history of medicine more remarkable than the elaborate expedients adopted, and the amount of actual discomfort and suffering endured, by persons who have been desirous of escaping military or other duty. The exhaustive works of Gavin and Marshall, and Boisseau and others, give us details no less ingenious than interesting of these devices; but it is curious to note in how limited a range the more traditional modes of imposture seem to run, and how the same old stories are made to do duty over and over again. Thus we read of blindness, and deafness, and epilepsy, and paralysis being carefully imitated, and can hardly withhold our admiration from the astonishing tenacity with which the apparent symptoms were duly maintained. Incontinence of urine, dysentery, hæmoptysis, jaundice, and insanity were among the most favourite rôles in the repertoire, and ingenious as were the preparations for duly sustaining the part, no less ingenious were the means for detection, which usually proved successful. However carefully the impostor had studied his character, some little point was usually omitted. The yellow conjunctiva of jaundice can hardly be feigned; the incontinence of urine was generally found to be attended by an expulsive effort; the blood apparently proceeding from the lungs was by no means intimately mixed with the pulmonary mucus; the blindness, or the deafness, or the paralysis were not proof against some sudden shock or mental impression. Most of the cases so carefully described by writers on military medicine are now mere matter of history, and are hardly likely to occur again. And the reasons for this are twofold. First: the inducement for deception is practically gone. In former days, when the soldier's pay was small and his hygienic condition bad, discharge from the service as an invalid was eagerly prized as a means of escaping irksome duty, but things have greatly changed for the better of late years. Not only is the emolument and the comfort of our army vastly increased, but short service and the Reserve enables men to retire early into civil life, whilst the abolition of bounty has removed the principal pecuniary inducement for frequent desertion and re-enlistment. It is now found much easier for a man simply to desert than to go through any elaborate process for the personification of disease. Again, the savage process of forcible impressment for naval service was naturally productive of many attempts to escape from the hard work and ferocious discipline of our men of war. Secondly: the process of science and improved means of diagnosis have rendered the task of the impostor difficult, if not well-nigh hopeless. Feigned blindness can hardly resist the test of the ophthalmoscope; electricity will clear up many apparently anomalous nervous symptoms; the stethoscope and the sphygmograph will tell us the real condition of the heart; and careful observation will detect the rougher attempts to deceive. Again, malingering may often be exposed by examination under chloroform or ether. We are not likely now to be taken in by a piece of liver tied to the breast to simulate cancer, or by an artificial nasal polypus; and although skin-diseases and ulcerations may be made or kept up by local applications, we only require a suspicion to cross our minds to put us on the right track for discovery.

We are not, however, to suppose that all attempts at deception have finally passed away, that feigned diseases are now things of the past. Anyone whose practice lies among prisoners or soldiers or schoolboys will very soon be convinced to the contrary. Experience, however, will soon show him what the schemers are, and enable him to circumvent their endeavours; and the range of symptoms simulated will soon be found to be singularly narrow. Subjective sensations are of course very difficult to detect, and if a headache, or pain in the back or leg or arm, be complained of by the sufferer, real or assumed, we may often find it best for our own reputation to give him the benefit of the doubt. A case which happened to the writer whilst medical officer to Rugby School, forcibly illustrates this position. A little boy complained on several successive mornings of most severe pain in the right calf, rendering him almost or quite unable to walk. Inspection could discover nothing wrong, there was no redness nor tenderness, and he had no recollection of any injury. Some suspicion of malingering was aroused, but it was thought most prudent to allow him to remain at rest. Four days later a red spot appeared about the middle of the calf, followed by a superficial abscess, which broke in due course, giving exit to half an ordinary sewing needle, which had evidently been working its way gradually upwards among the muscles of the leg. How it obtained admittance could not be ascertained. Whilst proceeding, therefore, with due caution, the practitioner must endeavour to hold the balance between an excess of suspicion and a too credulous attitude, remembering that the good of society and of the public service must be fairly considered, whilst all care must be taken not to confound the innocent with the guilty in dealing with disorders which ingenuity has occasionally been enabled to feign.

ROBERT FARQUHARSON.

FEIGNED INSANITY. *See* INSANITY, Feigned.

FESTER.—A superficial suppuration resulting from irritation of the skin; the pus being developed in vesicles of irregular figure and extent. The suppurating inflammation caused by a thorn or splinter of wood forced into the flesh is a common example of a fester.

FEVER (*ferveo*, I am hot).—SYNON.: *Pyrexia*; Fr. *Fièvre*; Ger. *Fieber*.

DEFINITION.—One of the most remarkable facts in connection with disease, is the rise of temperature which is attendant upon almost

every disturbance to which the body is subjected. This rise of the temperature of the body, when it attains a certain height, and lasts a certain time, is called Fever, and is accompanied by derangement of function, attributable to the febrile condition itself, and in a measure independent of the initial cause.

General Considerations. — Fever plays so important a part in acute disease generally, is accepted so universally as a mark of the severity of the disease, and so often presents itself as apparently the chief antagonist with which the physician or surgeon has to contend, that the attempt to penetrate the secret of its essential nature has always been a favourite task, and every school in every age has had its theory of the febrile process. It is only, however, within comparatively few years that exact measurement of the body-heat by the clinical thermometer, combined with chemical examination of the various excretions at different temperatures, and aided by the experimental method of investigation, has furnished the data for such a theory. A minute description of fever in the abstract, distinguishing, as would be required, between phenomena proper to fever, and phenomena due to the condition or lesion on which the fever depended would be lengthy, and so crowded with qualifications and exceptions as to be vague and unsatisfactory. The attempt, indeed, would have a more radical defect. Either some variety of fever must be taken as a type to which other forms are referred, which is vicious in principle; or all the phenomena of all febrile conditions must be enumerated and classified, which would confound the accidental with the essential, and would result in a heterogeneous collection of facts without due relation among themselves.

A mere outline therefore will be given of the principal deviations from normal functional action observed in fever, and the space set apart for the subject will be reserved for an exposition of what is known of the nature of the febrile process.

Description.—In every attack of fever there are traceable the three stages of invasion, domination, and decline, with or without an antecedent period of incubation. They may all be run through in the course of a few hours, as in a paroxysm of ague, or they may extend over weeks.

The period of invasion is characterised by a rising internal temperature, while the surface may remain cold and pale, the patient feeling chilly and suffering from rigors or shivering; the pulse is frequent, but generally small and long, from contraction of the arteries. During the dominance of fever the temperature remains high, the skin is hot, and the shiverings are replaced by a subjective sense of heat; the pulse is now full and bounding from relaxation of the arterial wall. The decline is indicated by a falling temperature, a softer and less frequent pulse, and by a return towards normal conditions generally; it may be initiated or accompanied by a critical sweat or other evacuation. Death may take place at any period of the disease.

Taking the temperature as the index of the duration and character of each stage, we may find it in the first stage rising abruptly or gradually, continuously or with remissions. If the invasion extends over several days as in enteric fever, nocturnal exacerbations and morning remissions are, as a rule, observed. A rapid rise of temperature is usually continuous, or nearly so. When the opportunity occurs of making the observation, as in intermittent or relapsing fever, or when fever is experimentally induced in animals, or in man by surgical operation or accidental septic inoculation, the increased heat is found to be the initial phenomenon, preceding the rigors and all other symptoms.

The end of the period of invasion, and the setting in of the stage of dominance, is more distinctly marked by the change in the character of the pulse, and by the determination of blood to the surface, together with the substitution of the subjective sensation of heat for that of cold, than by the thermometer.

During the dominant stage the temperature remains at, or oscillates about, a given point, and the fever is considered to be moderate if the morning temperature is 102° or under, and the evening not above 103°; to be high when it ranges between 103° in the morning and 104° in the evening; and to be severe when these limits are exceeded; while, with rare exceptions, a temperature of 106° indicates great danger. As the stage advances, the heat may gradually rise or fall; the oscillations being slight or considerable, and at times irregular and extreme. Except when the fever is due to local inflammation, or to continual entry into the blood of morbid particles or fluids, the duration of the dominance is usually in proportion to the time occupied by the invasion.

The decline again is generally abrupt, and has the character of a *crisis* when the invasion has been rapid, and is protracted when it has been gradual.

A fatal termination may be ushered in by hyperpyrexia; more commonly the temperature falls below the normal point and there is collapse.

The pulse is always increased in frequency by fever, but while during the height of the disease there is usually some relation between the body-heat and the pulse-rate, the pulse is often extremely frequent before the temperature has reached its height during the invasion, and it does not in all cases fall with it *pari passu* in the decline. The different stages are marked rather by differences in the character of the pulse than in its rapidity; during the period of invasion the arteries are more or less in spasm, and the pulse is small and long; during the dominance, with certain exceptions, the arterial walls relax, the vessels are large, and the pulse full and bounding; as the fever declines the arteries are still further relaxed, but the action of the heart is less powerful, so that the pulse becomes softer.

Respiration is frequent, following as a rule the pulse: the amount of carbonic acid expired is greatly increased.

The tongue is generally more or less furred, its appearance varying with the degree and kind of fever and with its cause. It becomes brown and dry, or unnaturally red in protracted and adynamic fever, when the teeth and lips may also be coated with sordes. There are almost

always thirst and loss of appetite. The bowels are usually confined.

The secretions are all more or less modified. The perspiration may be greatly increased as in acute rheumatism, or apparently checked, causing the skin to be dry and burning. The amount of urine will vary to a certain extent inversely with the amount of perspiration; but the tendency is to increase, and the solid organic matters—urea and other nitrogenised substances—are always considerably augmented in quantity. The chloride of sodium, on the contrary, is diminished.

The characteristic nervous phenomena of the stage of invasion are rigors, which may be slight, and represented only by shivering or chilly sensations, or, on the other hand, may be intensified to convulsion. Severe headache is more common at this period than in the later stage, and there is usually considerable depression. When the fever has reached its height the rigors will have ceased, and there may be little or much delirium according to the severity of the attack, or the idiosyncrasy of the patient, or, again, according to the kind of disease giving rise to the fever.

Pathology.—The description of the febrile state has been cut short in order to leave place for a discussion of the nature and cause of the febrile process.

This will be facilitated by a brief reference to the production and regulation of the heat of the body in health, and would be comparatively easy had physiologists arrived at a complete and satisfactory solution of this problem. In the normal state the main source of animal heat is blood- and tissue-combustion. Another very slight and unimportant cause will be obstructed motion of the blood in the capillaries: of direct conversion of nerve-force into heat we know nothing definite. The interesting and difficult part of the question is that which relates to the regulation of the temperature. It has been found that the changes which evolve heat are most active in muscle, in the nervous structures, and in the abdominal viscera; while in the lungs, any combustion which may take place is not more than will counteract the loss of heat by evaporation and by the expired air. The skin, on the other hand, is the great cooling agent; there is little combustion of its structures and it is continually losing heat by conduction when the surrounding temperature is low, but still more abundantly by evaporation under all conditions of external temperature. Heat is thus abstracted from the blood circulating in, and immediately beneath, the skin. At first sight then it would seem that the mechanism by which the temperature was regulated was extremely simple, and that it was to be found in the vaso-motor system of nerves. There being an internal heat-producing mass of tissue, and an external refrigerating surface, to raise the temperature, the arterioles of the skin are contracted, shutting off the blood, while those of the deeper structures are relaxed, allowing it to reach them in greater abundance; in this way a double influence is exerted, less heat is lost by the skin, and more is produced in the muscles and other internal parts. Conversely, the temperature would be lowered by flushing the skin with blood—which would thus be exposed to cooling influences—and diverting it from the heat-forming, deep-seated structures. This explanation, however, is inadequate; it is true that the distribution of the blood, superficially or deeply, by means of the vaso-motor nervous system, contributes largely to the regulation of the temperature, but heat-production in muscle or gland is not directly proportionate, simply to the amount of blood circulating through it; tissue-combustion, and consequent evolution of heat, are excited or repressed by cerebro-spinal nerves not governing the arteries. The nervous system thus intervenes directly in heat-production as well as indirectly through its influence on the circulation, and it has been shown that the stimulus to tissue-change and heat-production is a reflex from peripheral impressions. This is not the place to discuss the question whether there are special thermal nerves and centres, but it may be said that this has not been proved.

Taking the increased heat as the characteristic of fever, the first question which arises is whether this is due to increased production of heat, or to diminished loss. While the diminished circulation in the skin, in the early stage, will obviously tend to retain heat within the body, there is now no room for doubt that there is increased heat-production; the temperature rises in spite of profuse perspiration, when of course heat is very rapidly lost, as in acute rheumatism, or when perspiration has been induced by jaborandi before a paroxysm of ague (Ringer); and it has been shown by direct experiment that in fever a man raises the temperature of a given quantity of water in which he is immersed more quickly, and to a higher point, than in health (Liebermeister). It is unnecessary to give other proofs or further refutation of the hypotheses which explain the heat of fever solely by diminished escape of heat from the body.

It may further be taken as certain that the immediate cause of the increased generation of heat is increased blood- and tissue-oxidation. This is shown by the increased products of combustion given off in the different excretions. The febrile elevation of temperature is attended at once by increase in the amount of carbonic acid expired. This is more marked during the rise than when the heat has attained its maximum, because the increasing temperature expels the gases of the blood, and the greater rapidity of the circulation sends the blood more freely and quickly through the lungs, and exposes it more to the air. At first there will thus be eliminated not only the carbonic acid formed under the influence of the febrile process, but that which was held in solution by the cooler blood, and is driven off as its temperature rises; when the expulsion of dissolved carbonic acid is completed, the amount excreted will be diminished by so much, but it still remains larger than at the normal temperature.

A similar indication of increased tissue-combustion is furnished by the urine. The amount of urea is usually absolutely increased, notwithstanding a diminished consumption of nitrogenised food; or if the urea itself is not excreted in larger quantity, there is more nitrogenised

waste in other forms. The total of nitrogenised matter contained in the urine is always augmented by fever.

The real difficulty of the problem arises when we inquire what is the cause of the increased tissue-combustion. It has been already stated that the distribution of the blood to the deep structures and organs and to the skin respectively is not a sufficient explanation of the physiological balance of heat; but it might be supposed that the greater rapidity of the circulation in fever renewing the supply of oxygenated blood within the structures more frequently and more freely, would account for the greater oxidation. The rise of temperature, however, is not in proportion to the flow of blood through the vessels, and hyperpyrexia is often coincident with a failing circulation, the heat, indeed, apparently in some cases actually increasing after death.

One step towards the solution which may be considered certain is that the nervous system is concerned in the maintenance of the heat of fever. Each disease has its own characteristic range and variations of temperature, and this fact alone, that febrile heat is not vague and irregular, but that there is the substitution of a morbid for a normal balance, is evidence of nervous control. Numerous observed facts and experiments point to the same conclusion. We need only mention the hyperpyrexia often resulting from injuries to the brain, and following section of the cord in the cervical region.

Another item of positive knowledge obtained by experiment is that pyrexia may be excited by the introduction into the blood of septic or other matters, which, it is important to note, need not be particulate, but may be diffusible fluid. The increased heat may therefore be independent of capillary embolisms and of bacteroid or other organisms.

Now in disease or after injuries we have almost always both causes in possible operation —an impression on the nervous system, and the entry of altered organic matters into the blood. In endeavouring to assign prominence to one or other, we have, on the one hand, such facts as the hyperpyrexia of cerebral lesions, which cannot be due to blood-contamination, and, on the other, the teachings of antiseptic surgery, which demonstrate that absorption of putrescent discharges is the great cause of surgical fever. It still remains to be determined whether the presence in the blood of foreign matters gives rise directly to increased activity of oxidation, or whether the poison, as we may call it, produces this result through its action on the nervous system, either by affecting the nerve-centres themselves, or by producing irritation in the capillaries, which is carried to the nerve-centres, and reflected along efferent nerves. In the present state of our knowledge this question cannot be definitely settled.

If a theory of the febrile process is to be formed it must be based upon a theory of the relation between the nervous system and the processes of nutrition and oxidation, and especially the latter. Numerous facts of disease and of experiment point to the conclusion that the circulation of duly oxygenated blood through the tissues at the usual rate would, without some check to oxidation, result in more rapid tissue-change and the production of a higher temperature than the established norm. The restraining power is supplied by the nervous system, the loss of this influence being illustrated in hyperpyrexia. The mode in which the nervous system acts may be represented as being through the tension maintained in the nerve-centres. All nervous actions have the character of phenomena of tension, and the tension generated in the cells is sustained in the nerve-fibres to their peripheral terminations, where they are merged in the structures, and so blended with them that all nutritive and oxidative changes are common to the nerve-endings and the tissues in which they end. If we suppose that the nerve-tension can modify chemical action, as can electrical tension or thermal conditions, and that, *vice versâ*, the nutritive and oxidation changes in the tissues can influence the tension of the nervous structures, we can represent to ourselves the interaction between the nervous system and the blood and tissues in the febrile process. When from disease or injury of the great nerve-centres their power of maintaining tension is abolished, and their influence destroyed, the affinities of the blood and tissues have unrestricted play, and the result is hyperoxidation and pyrexia. When, on the other hand, septic matters or other substances are introduced into the blood, acting as ferments or in some other way, they increase oxidation, and directly raise the temperature, overpowering the restraining influence of the nerves until this is reinforced, which may possibly occur through increased evolution of energy, resulting from the increased activity of metamorphosis. We cannot, however, here develop or fully elaborate this hypothesis.

Treatment.—The treatment of fever is of course primarily directed to the removal of the cause on which it depends, but together with the measures adapted to this end are usually employed means for the moderation of the febrile process as such, and these may at times take the first place. We can do little more than mention the more important of them, taking first what may be called the general methods, and premising that rest in bed, simple food, &c., are taken as understood. Venesection is now scarcely ever practised as a means of combating fever. Purgatives are often useful, as are also diaphoretic and diuretic salines, with abundance of water to drink, either alone or in the form of some agreeable *tisane*. Free action of the secretions, which is the object of these remedies, is of service in removing the increased products of oxidation, the water taken co-operating by acting as a solvent and vehicle, and it is possible that medicines which promote this activity may directly bring down the temperature. When, for example, perspiration has been induced, a coincident fall of temperature may be due more to some change antecedent to the perspiration than to the loss of heat by transpiration and evaporation.

Of special measures for the reduction of febrile heat when this is becoming dangerous, either from its intensity or duration, the first to be mentioned is the cool or cold bath. This should be resorted to in all cases of hyperpyrexia, from

whatever cause; its efficacy, first established in the high temperature of acute rheumatism and enteric fever, has been proved also in cases of septic hyperpyrexia after ovariotomy, and even in injuries to the brain. Here the water may be positively cold. When the bath is employed to control temperature, not dangerous from its height, but from its duration, as in enteric fever, it need not be lower than 70° or 65° Fahr. An ice-cap devised by Mr. Knowsley Thornton, for applying cold of 32° to the entire head, has been found useful in hyperpyrexia following ovariotomy.

Many alkaloids have the property of reducing febrile temperatures when taken in large doses. The most powerful, and the one most generally employed to combat fever, is quinine. When given for this purpose, it is administered in doses of from ten to twenty or even thirty grains once in twenty-four or forty-eight hours, or three to six grains of the neutral sulphate may be injected under the skin. Salicylic acid has a remarkable influence on the temperature in acute rheumatism, and some effect, though far less marked, in fever from other causes. It may be added that when pericarditis has come on in rheumatic fever, this drug usually altogether fails to influence the temperature. The only other drug which need be specially mentioned is aconite, the mode of action of which is totally different from that of quinine, and of which it may almost be said that it antagonises the fever process rather than reduces temperature; its most marked influence being on the force of the heart and the contraction of the arteries. The opportunity for the manifestation of its powers occurs in the early stage of catarrhal fever, the result of chill. Given in frequent small doses (a drop or two of the tincture every five minutes till twenty minims or half a drachm has been taken) when the temperature is rising, the pulse frequent and hard, with headache and burning skin, the effects are often striking. When a local inflammation is established, it is no longer of much use; and when the fever is protracted, as in enteric fever, or when there is pneumonia, it may be dangerous, from its depressant influence on the heart. W. H. Broadbent.

FIBRILLATION, Muscular.—A localised quivering or flickering of muscular fibres. *See* Motion, Disorders of.

FIBRINOUS CLOT. *See* Clot.

FIBRINOUS CONCRETION. *See* Concretion.

FIBROID DEGENERATION.—A morbid change which consists in the substitution of a tissue somewhat resembling fibrous tissue for other structural elements; some pathologists consider this change to be of the nature of a degeneration. *See* Degeneration, and Cirrhosis.

FIBROID PHTHISIS.—A name given to certain cases of phthisis in which a considerable development of fibroid tissue is found to occur in the lungs. *See* Phthisis.

FIBROMA.—A form of tumour composed of fibrous tissue. *See* Tumours.

FIBRO-PLASTIC GROWTH.—A form of new growth, composed of fibro-plastic elements. *See* Tumours.

FICUS UNGUIUM (*ficus*, a fig; *unguis*, a nail).—A disease of the posterior wall of the nail. *See* Nails, Diseases of.

FILARIA SANGUINIS-HOMINIS.—In the article Chyluria a full account is given of the embryo-Filaria sanguinis-hominis, the hæmatozoon which is ordinarily found associated with this disease. Since that article was written, the writer has succeeded in obtaining what is beyond question the mature form of the helminth. On the 7th August, 1877, two living specimens were found—a male and a female—in the person of a young Bengalee, affected with well-marked nævoid elephantiasis of the scrotum, associated with the presence of embryo-filariæ in the blood.[1] The diseased tissues were removed by the late Dr. Edward Gayer, of Calcutta, to whose kindness the writer is indebted for the opportunity of examining them. Unfortunately the specimens were much injured by the needles used to tease the clot in which they were found: the terminal ends of the male could not be found, nor the caudal end of the female, although the fragments of both specimens manifested active movements. They were attenuated, fine, thread-like worms, of a white colour; the cuticle was smooth and devoid of transverse markings.

Fig. 18. Anterior end of Filaria sanguinis-hominis. — Mature form × 100 diameters.

The fragment of the male specimen measured half an inch in length, and $\frac{1}{180}$″ transversely; it was thinner than the female, but of firmer texture, and manifested greater tendency to coil. The intestinal canal measured $\frac{1}{633}$″ [·039 mm.] across, and the sperm-tube $\frac{1}{1500}$″ [·016 mm.].

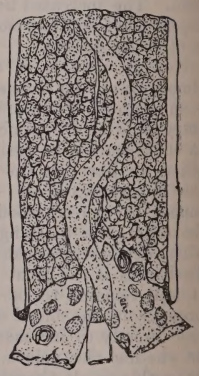

Fig. 19. A portion of the mature Filaria sanguinis hominis, showing uterine tubules filled with ova in various stages of development; also the intestinal tube. × 100 diameters.

The length of the portion of the female worm

[1] For further details, see *Indian Medical Gazette*, Sept. 1, 1877; *The Lancet*, Sept. 29, 1877; and *Centralblatt für die medicinische Wissenschaften*, No. 43, 1877.

which had been secured was 1½″, and its greatest width about $\frac{1}{100}$″. It was packed with ova and embryos in various stages of development; the latter, especially those which were mature, manifested active movements. The head is slightly club-shaped; the mouth does not manifest any very distinctly marked labial sub-divisions, nor are there any chitinous processes evident either before or after death.

The following measurements may prove useful to future observers:—

	of an in.	mm.
Oral aperture to end of œsophagus	$\frac{1}{55}$ or	·45
Diameter of oral aperture . .	$\frac{1}{3000}$ "	·008
Width of extreme end (anterior)	$\frac{1}{517}$ "	·047
Ditto anterior end at 'neck'	$\frac{1}{545}$ "	·045
Ditto opposite junction of intestine with œsophagus .	$\frac{1}{222}$ "	·112
Ditto about ¼ inch from anterior end	$\frac{1}{153}$ "	·162
Width where packed with ova and embryos	$\frac{1}{100}$ "	·25
Width of uterine tube filled with ova	$\frac{1}{222}$ "	·112
Ditto alimentary tube . .	$\frac{1}{666}$ "	·037

The ova do not possess any distinctly marked 'shell'; from the smallest to the largest nothing but a delicate pellicle can be distinguished as enveloping the embryo in all its stages. The average of six measurements of the least advanced kinds of ova, that is, those in which the outline of the embryo was not distinctly evident, was $\frac{1}{1304}$″ [·018 mm.] by $\frac{1}{2000}$″ [·012 mm.]; whilst the

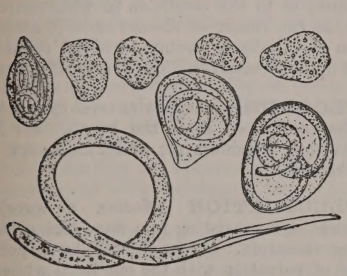

FIG. 20. Ova and embryos of Filaria sanguinis-hominis × 300 diameters.

average measurements of three ova in which the embryos were visible were $\frac{1}{666}$″ [·037 mm.] by $\frac{1}{766}$″ [·03 mm.]. When the latter, after having arrived at this stage of development, are examined during life, it is in many instances difficult to state whether they are to be considered as freed embryos or not, as the 'shell' has become so attenuated and translucent as only with difficulty to be distinguished. It is possible that when the embryo acquires worm-like proportions the envelope is not lost in this species so long as it continues in the blood.

With regard to the relation of the mature filaria sanguinis-hominis to pathological phenomena nothing very decisive can be said; but when it is considered that the blood of some animals is found occasionally to harbour minute, active organisms, in great numbers sometimes, without appreciable injury, it seems not improbable that the parental forms of nematoid hæmatozoa, rather than the embryos, may be the more hurtful to the animal economy. The lesions induced by the growth of the filaria sanguinolenta in the arterial walls of dogs, to which the writer has elsewhere drawn attention, appear to lend support to such a view.

In 1877, Dr. Cobbold announced that Dr. Bancroft, of Brisbane, had discovered specimens of what were believed to be mature forms of the filaria. A dead specimen was found in a lymphatic abscess of the arm; and on a second occasion four living specimens were obtained from a hydrocele of the spermatic cord. They were of the thickness of a hair and from 3 to 4 inches in length. A minute description of them by Dr. Cobbold appeared in the *Lancet* of the 6th October, 1877. The persons from whom the specimens were obtained had not suffered from either chyluria or nævoid elephantiasis, nor were they known to harbour embryo nematodes in their blood.[1]

TIMOTHY RICHARDS LEWIS.

FILARIÆ (*filum*, a thread).—A genus of nematoid worms, not very clearly defined, but which contains a variety of thread-like parasites whose body is of uniform thickness throughout, and at least fifty times longer than it is broad. Under this head are often included several human parasites, such as the *Dracunculus*, or Guinea-worm (*Filaria medinensis*), and the lung strongle (*F. bronchialis*), in addition to a variety of larval or sexually immature nematoids, whose genetic relations are only very imperfectly understood. In the latter category may be placed Bristowe and Rainey's entozoon (*F. trachealis*); Von Nordmann's eye-worm (*F. oculi-humani* or *F. lentis*); the *loa*, infesting the eyes of the Angola Coast and Gaboon negroes (*F. loa*); and lastly, the nematoid hæmatozoon (*F. sanguinis-hominis*) recently described by Lewis in his illustrated memoir. It may be doubted if any of the above-mentioned parasites ought to be included in the genus *Filaria*, as understood by modern helminthologists, but, practically, it is still found convenient thus to speak of them. The Dracunculus will be found described under GUINEA WORM; whilst the microscopic nematoid infesting the blood will be found noticed under the articles HÆMATOZOA, CHYLURIA, and FILARIA SANGUINIS-HOMINIS. T. S. COBBOLD.

FISH-SKIN DISEASE.—A synonym for ichthyosis. *See* ICHTHYOSIS.

FISSURE (*findo*, I cleave).—A narrow and superficial crack or solution of continuity, observed on the skin and mucous membranes, and especially near the line of junction of these structures, as on the lips and anus. *See* ANUS, Diseases of; and CHAPS.

FISTULA (*fistula*, a pipe).—A narrow track or canal leading from a free surface, and extending more or less deeply to some seat of local irritation, or it may be constituting an abnormal com-

[1] The researches of Dr. Manson, of Amoy, confirmed by Dr. Lewis, show that embryo filariæ in the blood are imbibed by the mosquito, or other intermediary host; undergo developmental changes; and are discharged into water with the larvæ of the insect. Infection probably occurs through this medium. Dr. Manson has recently stated (*Medical Times*, June 1881) that the habitat of the parent filaria is in the lymphatic trunks.—ED.

munication between two or more cavities, as in the case of vesico-vaginal or recto-vaginal fistula. *See* Abscess.

FISTULA IN ANO. *See* Rectum, Diseases of.

FIT.—A popular synonym for a sudden seizure characterised by loss or disturbance of consciousness from any cause, with or without convulsions. (*See* Convulsions, Epilepsy, Hysteria, and Syncope.) The term is also applied to a sudden or acute seizure of certain diseases, such as gout, asthma, and ague.

FLATULENCE (*flatus*, a puff of wind). Synon.: Fr. *Flatulence*; Ger. *Flatulenz*.

Definition.—The undue generation of gases in the stomach and intestines.

Ætiology.—The principal cause of flatulence is fermentation or decomposition of the contents of the stomach and bowels—a condition usually induced by embarrassment of function. Hence it is a common symptom in dyspepsia—especially the atonic forms as met with in the debilitated and the aged—constipation, gastritis, enteritis, hepatic disorders, intestinal obstruction, &c. When flatus is generated too rapidly to be accounted for by fermentation, as in hysteria, hypochondriasis, and other forms of nervous debility, it has been ascribed, but incorrectly, to secretion of gases from the mucous membrane.

Symptoms.—The clinical phenomena vary as flatus is retained or discharged; and with the seat of its formation, whether chiefly in the stomach or intestines. In the former the concomitant symptoms are those of dyspepsia, and in the latter there is usually constipation. As a rule, however, flatulence pervades at the same time more or less all the hollow viscera, and indicates torpor of the digestive organs. It is apt to lead to these further evils:—(*a*) *Pain* from distension or from irregular and forcible contractions of the walls—hence gastrodynia and colic are apt to arise; (*b*) *arrest of the normal movements* of the stomach and intestines, and consequent accumulation within them of fermentable matters, with further generation of gases, leading to paralytic distension; hence dilatation of the stomach and colon, tympanites or meteorism, and aggravation of pre-existing dyspepsia or constipation may ensue; and (*c*) *pressure on adjacent organs, e.g.* on the heart and lungs, inducing palpitation and irregular action of the heart, precordial anxiety, faintness, vertigo, dyspnœa or even asphyxia.

In tympanites there is a rapid generation of flatus, which overpowers the contractility of the hollow viscera; and the abdomen is round, tense and tympanitic. When this condition is accompanied by fever and diarrhœa, typhoid fever should be suspected; but if fever be absent, while there is bilious or stercoraceous vomiting, probably intestinal obstruction exists — intussusception, internal strangulation, hernia, &c.

Treatment.—(*a*) *Imprisoned flatus should be dislodged* by friction of the abdomen with stimulating liniments, and gentle kneading of the most distended parts; large draughts of hot water; spirit and hot water; ammonia, ether, or spirits of chloroform; aromatic stimulants—ginger, cloves, mint, anise, cajeput, camphor, cascarilla, &c. When flatulence is chiefly intestinal, enemata containing laudanum with assafœtida, turpentine, or rue; and pilula assafœtidæ composita with extractum nucis vomicæ, and an aperient are the most useful measures.

(*b*) *The generation of flatus should be arrested.* Fermentation may be checked by sulphite or sulpho-carbolate of soda, sulphurous acid, carbolic acid, creasote, or charcoal—from the poplar or vegetable ivory—immediately after food, and by correcting and toning the digestive organs. Food likely to ferment or lodge, such as starch, sugar, fruits or vegetables, and warm liquids—especially tea and soups—should be avoided; the meals should be well masticated and solid throughout, and liquids should only be taken sparingly at the close or an hour after. In some cases, however, flatulence is connected with an insufficient supply of fluids, and can only be met by increasing it. Alkalies—carbonate of magnesia, soda, or lime—and bitters, especially strychnia, are often useful in the flatulence of hysteria, hypochondriasis, the very nervous and the aged (Trousseau, Niemeyer); but perhaps the best results follow alkalies with nux vomica and bismuth an hour before, and hydrochloric acid alone or with Liebreich's Pepsin Essenz or other reliable preparation of pepsin after food. It is also essential to see that the action of the liver is healthy. George Oliver.

FLEXION (*flecto*, I bend).—A bending. This term is applied either to the act of bending, as in some methods of treatment, for example the cure of aneurism or the reduction of dislocations; or to the condition in which parts are bent, as the result of disease or of disorder, as when the limbs or certain internal organs are bent upon themselves. *See* Womb, Diseases of.

FLOODING.—A popular term for excessive discharge of blood from the womb. *See* Menstruation, Disorders of; and Pregnancy, Disorders of.

FLUCTUATION (*fluctus*, a wave).—A physical sign consisting in a wave-like or undulating sensation. It is elicited by a peculiar mode of palpation with the one hand while percussion is made with the fingers of the other; and is due to the presence of a fluid in a natural cavity such as the peritoneum, or in an abnormal closed space, such as a cyst (*see* Physical Examination). The term fluctuation as used by the surgeon has a somewhat different signification, being applied to the sensation of the presence of a fluid which may be felt when alternate pressure with the fingers is made, as over the seat of an abscess. *See* Abscess.

FLUKE.—In its original signification this term means anything flat; but, in connection with internal parasites, it refers generally to the common liver-entozoon and its allies, which happen to be more or less flat or leaf-shaped. The liver-fluke belongs to the genus *Fasciola*, though more commonly spoken of as a *Distoma*. Some of the flukes of man, as well as of animals, have a rounded form, quite unlike that shown by the ordinary liver-fluke. With one or two notable exceptions, the flukes are destitute of clinical importance. Under this head must

also be mentioned a remarkable fluke recently discovered by Dr. Lewis in India, and called by him *Amphistoma hominis*. As there is ground for believing that several allied species (*A. Hawkesii*, *A. Collinsii*, &c.) prove injurious to elephants and horses, it is possible that the human amphistome may be productive of severe intestinal mischief. *See* DISTOMA, and BILHARZIA.

T. S. COBBOLD.

FLUOR } (Latin).—A flow or excessive dis-
FLUX } charge from a mucous surface through any of the natural passages, of serum, blood, mucus, pus, or the various secretions. As illustrations of fluxes may be mentioned salivation, bronchorrhœa, biliary flux, diarrhœa, dysentery or bloody flux, cholera, and leucorrhœa or white flux (*Fluor albus*).

FŒTUS, Diseases of the.—Two classes of abnormal conditions are seen in the fœtus, namely:—Those which depend upon some interference with the process of development, such as malformations, monstrosities, &c., and those which are the result of disease. This article treats of the latter only.

1. *Amputation.*—Amputation, partial or complete, of fœtal limbs, may take place, from constriction of the limb by a band of the amnion. An attempt at reproduction of the lost limb is sometimes seen, in the shape of rudimentary fingers and toes, projecting from the stump. That such a stump is the result of amputation is proved by the fact, that the part cut off has been found *in utero*.

2. *Spontaneous fractures and dislocations.*—Fractures and dislocations occur *in utero*, the latter being the more rare. They are due to some condition of the bones and ligaments respectively, leading to undue fragility of those structures; for they are always multiple, and are not accompanied with bruising of the adjacent soft parts.

3. *Tumours.*—New growths are met with in the fœtus—cysts of various kinds, fibromas, lipomas, &c. That most special to the fœtus is a tumour situated over the coccyx, which may be as large as a fœtal head. Such tumours are spheroidal or ovoidal in shape, elastic in consistence, and present rounded inequalities on the surface. On section they are found to consist of strong fibrous trabeculæ, in the meshes of which are numerous small cysts lined with epithelium. It is thought by many that they originate in Luschka's gland. Another special kind of tumour is that known as a *fœtal inclusion*—a swelling usually on the lower part of the trunk, and containing some part of another fœtus, more or less imperfectly developed.

4. *Inflammation of serous membranes.*—This form of disease may occur in the fœtus, such as pleurisy and peritonitis. The morbid anatomy of these changes does not differ from that in the adult. Peritonitis is often found associated with syphilis; and it appears to be almost always fatal to the fœtus.

5. *Visceral Inflammation.*—Inflammation of the lungs has been met with, in the form of grey or white lobular hepatization. It is most frequent in syphilis. Enteritis has also been described. Various malformations of the heart which are met with can be explained by supposing the occurrence of endocarditis during fœtal life; but there is no proof that the fœtus is subject to rheumatism. Virchow describes encephalitis.

6. *Specific Fevers.*—The morbid changes of *enteric fever* have been found in the fœtus. In pregnant women suffering from *intermittent fever*, paroxysms of convulsive movements of the child have been felt to occur as regularly as the attacks of ague in the mother; and the child when born has been found to have a large spleen. Children have also been born with skin-eruptions thought to resemble those of *measles*, *scarlatina*, and *smallpox*. The facts as to the last-named disease are the most numerous and probable. The eruption of variola in the fœtus differs somewhat from that seen after birth, because, the skin of the fœtus being bathed with fluid, no crusts form, and the pustules run a course like those on mucous membranes.

7. *Diseases of the Skin.*—The fœtus is subject to skin-diseases. Pustules of ecthyma; patches of erythematous redness; ulceration of the skin, and syphilitic eruptions have been seen. Intra-uterine ichthyosis is met with. Children have been born jaundiced, but only by mothers themselves suffering from that disease. But women with jaundice do not always bear jaundiced children. Jaundice is not necessarily fatal to the fœtus.

8. *Syphilis.*—Syphilis leads to various lesions in the fœtus, and while it usually proves fatal, the subjects of it that may survive till birth are feeble and badly nourished. Flat tubercles occur on different parts of the skin, especially round the mucous orifices; and pemphigus, affecting chiefly the palms of the hands and the soles of the feet, may be seen. The occurrence of peritonitis has already been mentioned. Yellow indurated nodules, of varying size and number, may be found in the liver, as well as similar nodules in the lungs. A peculiar change has been described in the thymus gland, in which this structure externally appears healthy, but when cut into and compressed exudes a whitish puriform fluid. Other changes have been recorded, affecting the spleen, pancreas, and suprarenal capsules, but they are not distinctive. Changes in the bones have also been described, consisting of an osteo-chondritis, affecting the ends of the long bones, most frequently the lower end of the femur.

9. *Rachitis.*—Rickets is met with *in utero*. The changes it produces are like those seen after birth. It is thought to be one of the causes of spontaneous fractures.

10. *Tuberculosis.*—Tuberculosis sometimes commences in the fœtus, tubercles having been found in the mesentery and in the lungs.

11. *Dropsies.*—Dropsy is met with in the fœtus, sometimes of the serous cavities, of which hydrocephalus is the most common. It is often associated with rickets. Next in frequency comes ascites, and lastly hydrothorax, which is very rare. These affections may destroy fœtal life *in utero*; but they more often lead to death because they render destructive operations necessary before delivery can be accomplished. General anasarca is also met with, and there is reason to believe that it depends upon disease of

the placenta, impairing the excretory function of that organ. It is always fatal, if not before, within a few hours after, birth.

12. *Visceral diseases.*—Hypertrophy of the liver, spleen, or kidneys may occur in the fœtus. Cystic disease of the kidney may be met with, the organ being converted into a mass of cysts containing no trace of secreting structure. Both kidneys are usually affected, and the disease is generally associated with some malformation elsewhere. Hydronephrosis, single or double, along with dilatation of the ureter, or ureters and bladder, has been seen, dependent upon impermeability of some part of the urinary passages. Any of these visceral diseases may form a tumour so large as to impede delivery. None of them can be diagnosed before birth. Concretions of uric acid and urates are not uncommon.

The Causes of Death of the Fœtus.—The various causes of death of the fœtus *in utero* may now be briefly considered. The first of these is *injury*, as when the mother receives a blow upon the abdomen, or has a fall. Such occurrences rarely directly injure the fœtus, although this has been known to happen. When they prove fatal to the fœtus, they do so by leading to hæmorrhage into, or separation of, a portion of placenta, and consequent disturbance of the fœtal circulation. *Poisons* in the mother's blood, such as lead, urea, or carbonic acid (as in the case of heart-disease with cyanosis), may lead to death of the fœtus. *Syphilis* has already been referred to. Epileptiform *convulsions* may destroy fœtal life, either by asphyxia, or by leading to hæmorrhage into the placenta. Extreme *anæmia* and the *cancerous cachexia*, are among the causes of fœtal death. Any kind of disease attended with *pyrexia* will also destroy fœtal life if the temperature rise high enough. A temperature exceeding 105° Fahr. appears to be invariably fatal to the fœtus. Certain *diseases of its appendages* may lead to death of the fœtus, such as fatty degeneration, or œdema, of the placenta; obliteration of the umbilical vessels; or interruption of the circulation in the cord by knots in it, or pressure upon it. It is believed that there are some *diseases of the mother's uterus* which lead to death of the fœtus; but what they are is not known. It is said that some women acquire a habit of having dead children. This means that there are cases in which an apparently healthy woman will repeatedly have dead children, the cause of whose death a skilled observer cannot find out. In other words, there are causes of fœtal death as yet unknown.

The Consequences of Death of the Fœtus. A dead fœtus while retained *in utero*, and thus protected from the air, does not putrefy, but undergoes a process of maceration. The whole body becomes soft and flaccid, its tissues being infiltrated with fluid; but it has no putrid odour. The skin presents bullæ filled with reddish serum, and the epidermis is readily detached with slight friction. The surface is of a cyanotic colour, which after exposure to the air becomes of a more or less bright red; it is not greenish, as is seen in putrefaction. The cellular tissue is infiltrated with bloody serum. The viscera have lost their distinctive tints, and become of a reddish-brown colour. The cranial bones are abnormally mobile, overlapping one another to a greater extent than normal; and the periosteum may be stripped off them. These appearances are much the same, whatever be the cause of death, but they vary in degree according to the length of time which has elapsed since death.

Besides the diseases of the fœtus described above there are others which are not fatal, and the chief interest of which lies in their course and treatment after birth. These are discussed in other articles, and for that reason are not mentioned here. G. E. Herman.

FOLIE CIRCULAIRE (*French*).—This term is applied by the French psychological physicians to a variety of insanity characterised by alternations of excitement and depression. The patient passes through an attack of mania of perhaps an ordinary character but when he appears to have recovered he sinks into melancholia, and thence emerges again to become maniacal and excited. The duration of each stage may vary from weeks to months; sometimes one state will follow the other immediately; in other cases a period of convalescence will intervene, during which the patient appears well, and can hardly be considered insane. Yet the prognosis is extremely unfavourable in all such cases, and it is of great importance in estimating the extent of recovery of a patient that it should be clearly ascertained that the attack is not one of a series following one another in the manner mentioned. G. F. Blandford.

FOLLICLES, Diseases of (*folliculus*, dim. of *follis*, a bag).—The name 'follicle' has been applied to a great variety of different structures, which have in common the shape of a bag or sac, whether circular or elongated in outline; for example—the Graäfian follicles, the lymphatic (Peyerian) follicles of the intestine, and the follicles of the mucous membrane of the stomach, intestine, and uterus. The name has been further extended to include glands somewhat more complex in structure, such as the sudoriparous glands or sweat-follicles, the sebaceous follicles, and the tonsils; as well as the saccular depressions in which the hair and the teeth take their origin. The name *Synovial Follicles* is sometimes given to processes of synovial membrane invaginated in the capsule of a joint.

For an account of the diseases of these various structures, the reader is referred to the several articles under which they are discussed; but so far as the true follicles are concerned, the following may be said to be the principal morbid changes to which they are liable:—Atrophy; Hypertrophy; Obstruction, and Distension; Inflammation; Ulceration; Cystic Disease; New Growths; Tubercle; Acute Specific processes, such as the typhoid; and Parasitic disease.

FOMENTATION (*foveo*, I keep warm). Synon.: Fr. *Fomentation*; Ger. *Bähung*.

Definition.—Fomentation is the application to the surface of the body of flannels, cloths, or sponges moistened with hot water, either pure or containing some medicinal substance in solution.

Action.—The action of a simple fomentation is the same as that of a poultice. By its warmth and moisture it tends to relax the muscular fibres

of the skin, and soften the cuticle, thus relieving tension, and diminishing pain and irritation. In the early stages of inflammation it favours resolution, by maintaining the temperature and promoting active circulation through the area which has suffered from the injurious influence which has started the process. In the later stages it promotes and hastens suppuration, by causing dilatation of the vessels, and hastening exudation and cell-multiplication. A fomentation is superior to a poultice in lightness and cleanliness, but unless care be taken it loses its heat more quickly. This disadvantage may be overcome by covering the fomentation with a thick layer of cotton-wool.

Application and Uses.—A fomentation is thus applied:—A piece of coarse flannel, or of spongio-piline, sufficiently large to cover the affected part when folded into two layers, is put into a basin and boiling water is poured upon it. It is then lifted from the basin with a pair of tongs or some convenient instrument, and dropped on the wringer. This is a stout piece of towelling with a stick attached to each end. The sticks then being twisted in opposite directions, as much water as possible is squeezed out of the flannel. It is then immediately placed on the affected part, and covered with a large piece of oiled silk or indiarubber sheet extending at least one inch on each side of it. Over this may be placed a thick layer of cotton-wool, and a bandage. If the flannel be not squeezed sufficiently dry it will wet the bed or clothing. If not sufficiently covered with oiled silk and wool it soon becomes cold. Whatever means may be taken to retain the heat of a fomentation, it can be kept above the temperature of the body only for a few minutes. If, therefore, the full effect of fomentation is desired to be obtained, the flannels must be changed every twenty minutes. In many parts a sponge, or a piece of spongio-piline, wrung out of boiling water forms a most convenient form of fomentation. When the fore-arm or hand is affected, a bath of hot water may be substituted for fomentations. The temperature of the water must be maintained by the repeated addition of small quantities of boiling water.

Fomentations are especially useful in all cases of erysipelas and diffuse cellulitis, and in boils. In peritonitis they are borne more easily than poultices, on account of their greater lightness. Whenever they can be employed they are superior to poultices on account of their cleanliness. They are not applicable to cases in which there is a discharging wound or abscess, as under such conditions the cloths become foul.

Varieties.—If it is desired to add some slight counter-irritation to the warmth and moisture, the fomentation may be sprinkled with turpentine before it is applied. This forms the ordinary *turpentine-stupe*. The sedative action of the fomentation may be increased by sprinkling it with laudanum. The ordinary poppy-fomentation is often used with the same intention. It is thus prepared:—Half a pound of poppy-heads with the seeds taken out is boiled for ten minutes in four pints of water, and the liquid then strained off. The decoction is kept warm over a fire and the flannels dipped in it and applied as before described about every half-hour. The term 'dry fomentation' is sometimes applied to bags of salt, hot bran, or chamomile flowers; or pieces of flannel toasted before a fire and applied hot. These often give relief in cases of intestinal, renal, or biliary colic. Marcus Beck.

FOMITES (*fomes*, fuel).—Substances capable of retaining contagium-particles, and thus of being the means of propagating any infectious disease. The most important fomites are bed-clothes, bedding, woollen garments, carpets, curtains, letters, &c. *See* Contagion.

FOOD. *See* Aliments, and Diet.

FOOD, Æetiology of.—*See* Disease, Causes of; and Digestion, Disorders of.

FORAMEN OVALE, Patency of.—*See* Heart, Malformations of.

FORCIBLE FEEDING.—In the treatment of insanity it not unfrequently happens that we are compelled to administer food by force to patients who, for one reason or another, refuse to take it. The majority of them are melancholic persons who think they ought not to eat, or try to commit suicide by starvation, and many are in a feeble bodily condition when they commence this refusal. Such persons must be fed by force without delay. Strong patients may be allowed a longer time, for many refuse from whim or obstinacy, and hunger will soon overcome their disinclination. Some patients in a state of acute delirium will take no food; they must be fed at once, and it is important that they should be fed without a protracted and exhausting struggle, for they will resist desperately unless completely overmastered. In almost every case feeding should be done early: the sooner it is done, the shorter will be the period during which it will be required. What method is to be adopted? The various plans range from merely feeding with a spoon as one feeds a child to sending food down the œsophagus with a tube passed through the mouth or nose, the patient being restrained in a chair or on a bed by attendants or mechanical restraint. The mode of feeding varies according to the resistance, and no one method is applicable to every case. There is no need to pass an œsophageal tube down the throat of a man whose resistance is passive and easily overcome; on the other hand we occasionally find patients of great muscular strength and indomitable will, who can hardly be fed with safety in any way except by the stomach-tube. Of these we may speak first. In what position are they to be fed, sitting or lying down? If they are to be held by attendants no doubt the recumbent posture is the one in which the latter can exercise most power. But when a man is so strong that, as we are told, five attendants must hold him, a struggle will not be unattended with danger, for the five are not all acting together, and he gets loose now a leg and now an arm, to the great discomposure of the operator: moreover this struggle repeated three times a day soon renders him a mass of bruises. He should be placed in a strong wooden chair, and by sheets wound round his body, arms, and legs he can be fastened to the chair so completely that he is as incapable of movement as if he were paralysed,

yet he gets no bruise, and the operator acts upon him free from all inconvenience. Some writers advocate feeding by the nose, and prefer this method to passing a tube through the mouth. But if a long tube is used it is apt to get into the larynx, and if the food is passed into the nose through a funnel or feeder, it is often ejected again. The only advantage of feeding through the nose is that we are not compelled to force open the mouth. This is a work of difficulty if the patient is strong and his teeth perfect, unless we are provided with the screw-key invented for this purpose: with this there is little difficulty, and only bungling will injure the teeth or gums, if the patient is properly secured and the head held by an attendant, not between his knees but in his hands. If the œsophageal tube be of good size it cannot enter the larynx. The wooden termination of the tube must be short, so as to allow of its curving. The operator standing in front passes the tube through the hole of the gag, inclining it to the patient's left, so as to avoid the vertebræ. It may be held by the tongue, but at the first inspiration the hold is relaxed, and it glides down the œsophagus. The food may be poured down it by a funnel or pumped down by the pump. The next class of patients, making less resistance, may be fed by Paley's feeder, a glass vessel with a flattened spout which goes over the tongue: the food is emitted, a little at a time, by means of a spring, and finds its way down the gullet. A certain number of patients may be fed by getting a funnel behind the teeth and pouring food into it; and others by holding the mouth open by means of two spoons, and then pouring food in. The objection to the latter method, and to its many modifications, is the time taken up in the operation, whereby great fatigue and exhaustion are produced. G. T. Blandford.

FORMICATION (*formica*, an ant).—An abnormal subjective sensation referred to the skin, which is described as of a 'creeping character, and as resembling the crawling of ants upon the surface. *See* Sensation, Disorders of.

FOURTH NERVE, Diseases of.—Morbid states of the fourth nerve are shown in spasm or paralysis of the superior oblique muscle which it supplies. Little is known of overaction of this muscle. Clonic spasm in it is seen in rotatory nystagmus. Paralysis is not uncommon. Its usual causes are inflammation of the nerve-sheath from cold; syphilitic affections of the nerve or of its membranes; cerebral tumours &c., pressing on or injuring the nerve at its origin from the valve of Vieussens, or in its course around the crus; aneurism; exostoses or growths in the orbit; and degeneration of the nucleus, in common with the nuclei of the other nerves of the ocular muscles.

Symptoms.—Even in complete paralysis of the superior oblique muscle there is little obvious deviation of the affected eye. Movement downwards is, however, defective, and therefore diplopia exists when the eye is moved below a line which runs obliquely downwards from the healthy to the paralysed side, through the point of midfixation. Movements which necessitate a downward position of the head are therefore chiefly interfered with, and it is common for the first discovery of a defect to be that the patient becomes giddy when he goes downstairs, in consequence of seeing two flights of stairs before him instead of one. The chief visible defect in movement of the affected eye (examined alone) is downwards and inwards, because it is when the eyeball is moved in these directions that the superior oblique has most influence on the vertical position of the eyeball. The defect in the rotation of the eyeball is greatest when it is moved downwards and outwards. The diplopia which exists when both eyes look down is homonymous, that is, the image formed by the affected eye is on the same side as that eye. The left eye being higher than the right, its image (the left) appears lower than the right image. The action of the superior oblique being to move the upper end of the vertical axis of the eye inwards, there is in its paralysis an abnormal divergence of the upper ends of the vertical axes, and the double images (being always inverted) will converge; their upper ends being nearer together than the lower. This is due to the obliquity of the false left image, and this obliquity is greatest when the eyeball is moved to the left and downwards, because in this position the rotatory power of the superior oblique is greater, and the obliquity is least in looking inwards and downwards. Thus the convergence of the images is greatest when the difference in height is least, and *vice versâ*. When the paralysis of the superior oblique has existed for some time, a secondary contraction of the inferior oblique may cause crossed diplopia in looking upwards.

Treatment.—The treatment of paralysis of the fourth nerve is in the main that of its cause. When due, as it very commonly is, to syphilis, iodide of potassium in full doses, with or without mercury, is necessary. Smaller doses of iodide with quinine or iodide of iron are also useful for rheumatic paralysis. Blisters to the temple in the early stages are useful. A little, but not much, good may be effected by applying the constant current from the eyelid to the forehead (Benedikt), a few cells only being used.

W. R. Gowers.

FRAGILITAS CRINIUM (*fragilitas*, brittleness; *crinis*, the hair). *See* Hair, Diseases of.

FRAGILITAS OSSIUM.—A diseased condition of the bones in which they are extremely fragile, so that they are liable to fracture from very slight causes. *See* Bone, Diseases of.

FRAMBŒSIA (*framboise*, a strawberry).—Synon.: Yaws; Fr. and Ger. *Pian*.

Definition.—Frambœsia consists of an eruption of yellowish or reddish-yellow tubercles; which gradually develop into a moist exuding fungus without constitutional symptoms, or with such only as result from ulceration and prolonged discharge, namely, debility and prostration.

Ætiology.—This disease is peculiar to the African race, both in their native country and in the West Indies. Yaws are epidemic; they are also contagious by actual contact, and consequently inoculable. The period of incubation of the poison ranges from three to ten weeks, and, except in rare instances, the disease occurs only once in a lifetime.

SYMPTOMS.—The tubercles begin with little or no hyperæmia, and range in size between that of a pin's head and a prominent mass one or two inches in diameter. Some subside without piercing the cuticle, and disappear without causing disorganisation of the skin. When the cuticle is penetrated, the tubercles assume the appearance of a fungous mass of spheroidal figure, yellowish or pinkish in colour, and moistened with a dirty-yellow, fœtid secretion. At a later period the fungus shrinks in size, and is converted into a yellow and brownish scab; at other times the ulceration extends deeply and widely into the tissues. The subsidence of the eruption is succeeded by a pigmented stain, and the healing of the ulcers by a pigmentary cicatrix.

The eruption selects by preference as the seat of its development, the face and neck, the limbs, the feet, and the genital region, and is frequently found around the mouth, the apertures of the nostrils, the eyelids and the anus, where it is apt to present a thick fringe of tubercles or a broad prominent band or ridge.

COURSE AND TERMINATIONS.—The ordinary duration of framboesia extends from two to four months, but frequently this period is prolonged to one or several years. When it is irregular in its development the constitution is apt to suffer, ulcers form around the joints, the joints swell, the discharge from the ulcers is excessive, the exhalations of the body are highly offensive, and the patient is crippled for life, or in some instances relieved only by death.

TREATMENT.—The treatment of yaws, according to the best authorities, consists in cleanliness, generous diet, the local use of carbolic acid lotions and diluted nitrate of mercury ointment; and the employment of constitutional remedies, of which the most useful are mercury, with sarsaparilla or a decoction of the woods, iodide of potassium, and tonics. ERASMUS WILSON.

FRANCE, South of.—The eastern part (Mediterranean Coast) is dry and bracing, with a very clear atmosphere. The chief resorts in it are CANNES, MENTONE, HYÈRES, and NICE. The western part is moist and mild but variable, the principal places in it being ARCACHON, BIARRITZ, and PAU. *See* CLIMATE, Treatment of Disease by.

FRANZENSBAD, in Austria.—Alkaline sulphated waters. *See* MINERAL WATERS.

FRECKLES.—SYNON.: *Lentigines*; *lenticulæ*; Fr. *ephelides*; Ger. *Sommersprossen*, *Sommerflecken*.—A freckle is a pigmentary discoloration of the skin, which has received its Latin or technical name from a resemblance in colour, figure, and size to a lentil. It varies in tint from yellow to olive, from brown to black; and is met with on the exposed parts of the skin, particularly the face, neck, and hands, and occasionally on the covered parts of the body ('cold freckles'). It is usually found in children and women in whom the skin is sensitive and delicate, and has obtained its German synonyms from its greater frequency in the summer season. *See* PIGMENTATION, Disorders of. ERASMUS WILSON.

FREMISSEMENT CATAIRE (*fremissement*, purring; *cataire*, connected with a cat). A physical sign felt on applying the hand over the region of the heart or great vessels in certain morbid conditions; and compared to the sensation conveyed to the hand by the purring of a cat. This sign is more commonly known as 'thrill' or 'purring tremor.' *See* PHYSICAL EXAMINATION.

FREMITUS (*fremitus*, a loud noise).—A group of physical signs, elicited by placing the hand over the respiratory organs, while the patient speaks (*vocal fremitus*), or coughs (*tussive fremitus*); or in certain morbid conditions when the patient simply breathes (*rhonchal*, and *friction-fremitus*). A fremitus may sometimes also be felt over the cardiac region in connection with the movements of the heart, when the surfaces of the pericardium are much roughened. Another form of fremitus is a peculiar sensation called *hydatid fremitus*, which may be elicited by a special mode of percussion over hydatid tumours in some cases. *See* PHYSICAL EXAMINATION.

FRICTION.—SYNON.: Rubbing; Fr. *Friction*; Ger. *Reibung*.

DEFINITION.—By friction we mean surface-rubbing, as distinguished from *shampooing*, or as it is sometimes called *medical rubbing*, a process of manipulation by which deep pressure is made upon the muscles.

APPLICATIONS AND USES.—Friction is usefully employed over the surface of a limb, or the trunk, for a variety of purposes. It is especially useful when the circulation is enfeebled, either by the external application of cold, amounting when in a severe degree to frost-bite, or in cases of paralysis. The effect is still further increased by the use of various stimulating liniments and embrocations, more especially when it is desirable to excite a certain amount of counter-irritation over a large cutaneous surface for the relief of congestion or inflammation of internal organs.

Another object with which friction is largely employed in medicine, is to facilitate the absorption and introduction into the system of various remedial agents applied externally, instead of being administered internally by the stomach. By this means gastric irritation and disturbance are avoided, and the effects of the remedies upon the system can be more closely watched and regulated. In this way mercury is frequently introduced into the system by the process commonly spoken of as *rubbing in*, and salivation can be more easily avoided or checked at its commencement than when mercury is administered by the mouth. The part of the body selected for this purpose is that along the inner side of the thigh up to the groin, and mercury, rubbed in, in the form of ointment, every night and morning, will generally affect the system in a few days.

Another instance of friction is to be found in the fattening of children by the process of rubbing in oil—fresh neat's-foot oil is the best—every night and morning, over the chest, abdomen, arms, and thighs. Emaciated children thus treated gain in weight by the absorption of the oil; and not only do they fatten, but their general nutrition and health are improved, often with the diminution of glandular swellings and the disappearance of coughs, so

that there is some ground for the belief in the curative influence of this method of medication in incipient phthisis. WILLIAM ADAMS.

FRICTION-FREMITUS.—The form of fremitus produced by the rubbing together of surfaces roughened by various morbid conditions, as of the pleura in breathing, or of the pericardium from the movements of the heart. *See* FREMITUS, and PHYSICAL EXAMINATION.

FRICTION-SOUND.—A physical sign, heard on auscultation, and due to the rubbing against each other of serous surfaces that have lost their natural smoothness and moistness from any cause. *See* PHYSICAL EXAMINATION.

FRIEDRICHSHALL, in Germany.—Sulphated waters. *See* MINERAL WATERS.

FROST-BITE.—A local effect of extreme cold upon any of the tissues of the body. *See* COLD, Effects of Extreme or Severe.

FUMIGATION (*fumigo*, I smother).

DEFINITION.—This is a mode of employing certain medicinal agents which are capable of being volatilised by heat, the vapour being then allowed to escape into an apartment, or to come in contact with articles of clothing and other objects, for purposes of disinfection (*see* DISINFECTION); or being allowed to act upon the surface of the body as a whole, or upon certain parts of it, for therapeutic purposes, either local or general, on being absorbed. The chief agents which are thus used are sulphur and mercury.

MODE OF APPLICATION AND USES.—The mode of using sulphur as a disinfectant will be found sufficiently explained under the article DISINFECTION. The vapour may also be brought with a therapeutic object into contact with the body or any part of it in the dry state, the sulphur being burnt in a suitable apparatus. As a general application it is used for the cure of itch; as a local application in diseases of the throat, and various other affections.

Mercurial fumigation is now commonly effected by means of the moist mercurial vapour bath, in which the skin is exposed to the fumes of mercury volatilized by heat and mixed with steam, in a suitable apparatus. This process is more effectual than dry fumigation, for the moistened skin is more capable of receiving and absorbing the mercurial vapour which settles upon it. It is not desirable to produce profuse perspiration, as this exhausts the patient, and washes the mercurial film from the body.

Various preparations of mercury have been tried, but by far the best is calomel as recommended by Mr. Lee, which is capable of being more completely volatilized than any other form and with a less degree of heat, whilst the amount administered is more accurately known. The quantity used for each bath may be varied from 10 to 30 grains, and given daily or at such intervals as circumstances indicate. The body should be protected from cold after leaving the bath, and night is the best time for its use, as the patient can then go to bed enveloped in the cloak or blanket which has been employed in the process, and upon which much of the vapour has collected. Salivation is readily and often quickly produced by this method, so that the gums must be carefully watched and the dose regulated. The time ordinarily required for the bath is about 20 minutes, but if headache or lassitude be caused, it must not be so prolonged.

The advantages of this practice are that mercury can be introduced into the system without giving rise to the intestinal derangements, loss of appetite, &c., which its exhibition by the mouth sometimes occasions, and its direct action upon the skin often appears to be of service. There is, however, the disadvantage that in some cases the mercurial fumes may cause a syphilitic eruption to inflame and spread.

Mercurial fumigation has been employed for primary syphilis, but it answers best in the secondary stage of the disease, and especially for the dry eruptions. Sometimes it is useful for the tertiary manifestations which resist iodide of potassium, but it should be tried very cautiously in these cases.

In certain cases where, from feeble health or other causes, it is not advisable to influence the system with mercury, the calomel vapour may be directed upon some local parts, such as an ulcerated spot. This local application has been found serviceable in treating intractable sores in advanced syphilis, in severe and obstinate ulceration of the throat, and in some other conditions.

GEO. G. GASCOYEN.

FUNCTIONAL DISEASES.—A class of diseases in which an anatomical change cannot be detected to account for their presence. *See* DISEASE, Classification of.

FUNGI, Diseases due to. *See* PARASITES, Diseases from; and MUSHROOMS, Poisoning by.

FUNGOID (*fungus*, a mushroom).—A term applied to superficial granulations and morbid growths, especially those of a malignant nature, when they sprout rapidly and assume an appearance somewhat like a mushroom. *See* CANCER, and ULCERATION.

FUNGUS-DISEASE OF INDIA.—SYNON.: Madura Foot, Mycetoma; *Morbus tuberculosus pedis*; Fr. *Dégénérescence endémique des os du pied· Pérical.*

DEFINITION.—A diseased condition of the hands and feet, occurring in India, characterised by enlargement and distortion of the affected extremity, due to thickening of the cutaneous tissues, with degeneration and subsequent fracture of the osseous structures. Two forms of the malady are described—one, the pale or ochroid form, characterised by the presence of minute globular fatty particles like fish-roe, and, though very rarely, by the existence of minute pink concretions not unlike red-pepper granules; the other, the melanoid or dark form, characterised by the existence of black or dark brown masses, varying in size from that of a grain of gunpowder to a walnut, and composed of fungoid filaments, cells, and pigmentary deposit.

DESCRIPTION.—This remarkable disease of the extremities does not appear to have been observed hitherto beyond the limits of Hindostan,

and has rarely been seen to affect any but the natives of that country. No case of a European or half-caste has been recorded as suffering from a typical form of the malady. The foot has been observed to be affected more often than the hand; hence it was common formerly to find the malady referred to as one peculiar to the foot. It has been recognised as a distinctive disease in India for more than thirty years, and was described by Goodfrey, of Madras, in the *Lancet* in 1846, and by Eyre in the *Indian Annals of Medical Science* in 1860. It is to Dr. Vandyke Carter, however, that we are chiefly indebted for what is known of the malady, clinically and pathologically, and his writings date as far back as 1860. His recently published memoir on the disease (*Mycetoma, or the Fungus Disease of India*, 1874) contains a summary of all that had been written regarding it up to the period of publication.[1] The foot or hand affected with the disease presents appearances not unlike what are observed in some of the forms of caries—especially those of scrofulous origin. When it is the foot that is affected, it is found to be considerably increased in circumference, the enlargement seldom extending far beyond the ankle; the foot is prone to run in a line with the leg, and may be everted or inverted. It is not, however, in the aspect presented by the limb that the leading peculiarity consists, but in the character of the discharges from the sinuses, the openings of which are scattered all over the surface of the affected tissue. It is this peculiarity which led Dr. Carter to separate the disease into two forms, (1) the 'pale' or 'ochroid,' the discharge of which consists of whitish-yellow roe-like bodies of about the size of millet-seed; and (2) the 'dark' or 'melanoid,' so called from the dark brown or even black granular bodies that constantly escape through the sinuses, not unlike grains of coarse gunpowder. The first form may be said to present two or three varieties, according to the modified character of the discharges: these will be referred to more definitely farther on. The malady would appear to occur more frequently in Madras, Bombay, and the more westerly and north-westerly parts of India than in Bengal proper. This, however, seems to apply more especially to the dark variety; for, whilst no well-authenticated case of this form has been recorded as having manifestly originated in the last-named province, cases of the pale variety are not unfrequent. So far as the foot is concerned, the pale form is manifestly the one most commonly met with all over India, at least, if any inference may be drawn from the fact, that whilst the writers have had the opportunity of examining two or three hands affected with the dark variety, they have not seen one affected with the pale; nor can they find any account of such a case having been witnessed. The distortion of the hand affected in this manner is very peculiar—it is shortened and thickened, owing to the destruction of the carpus and metacarpus, and the consequent irregular tension of the extensor and flexor tendons.

Anatomical Characters.—On laying open a characteristic specimen of the disease, the bones are found to be extremely softened, so that they can readily be divided by means of a common knife. The interior of the hand or foot is found to be occupied by a series of sharply defined cavities, some quite isolated, but the majority communicating with one another and with the exterior by a series of complex channels or sinuses containing glairy fluid and solid concretions in various proportions. Both cavities and channels are lined by a dense, glistening membrane composed of white fibrous and elastic tissue. The surrounding tissues are generally in a very fatty condition, and, where the disease is of long standing, are more or less completely blended into an indistinguishable mass. So far a common description is applicable to both forms of the disease; but on proceeding to the consideration of the contents of the cavities, great differences present themselves.

Pale Form.—The pale or ochroid form is capable of subdivision into several varieties, according to the nature of its morbid products. In the commonest and most characteristic variety the cavities and channels contain masses of spherical bodies like fish-roe, of a pinkish-yellow or white colour, surrounded by gelatinous glairy matter. In certain cases, however, the roe-like bodies are almost or entirely absent, and the gelatinous matter and liquid oil are generally diffused throughout the tissues. In a third and very rare variety the section looks as though besprinkled with grains of red-pepper, from the presence of innumerable minute concretions of a bright red hue.

Dark Form.—The appearances presented in the dark form of the disease are strikingly different. Here, in place of the roe-like bodies of the previous form, the cavities and channels contain masses of a dark brown or black colour. These masses vary greatly in size, some not being larger than the normal fat-lobules surrounding them, others attaining to the size of a small orange. The larger masses greatly exceed any of the roe-like masses of the pale variety in size, and their consistence is also much firmer than that of the latter. They are tuberculated on the surface, and closely resemble truffles in appearance. On section, they present a more or less distinctly radiating structure, and the interior is generally somewhat lighter in colour than the tuberculated exterior coating. In some cases they are tightly fitted into the cavities in which they lie, but in others they lie loose and are surrounded by a certain amount of gelatinous matter. The amount of the latter present is, however, much less than in the pale form.

The masses of morbid material in both forms are primarily situated in spaces normally abounding in fat. Long series of them are frequently interpolated among the loculi in the

[1] Bibl.: Carter, H. V. *Trans. Med. & Phys. Soc. of Bombay*, 1860–62. *Trans. Path. Soc. of London*, vol. xxiv. 1873. *On Mycetoma, or the Fungus-disease of India*, London, 1874. Carter, H. J. *Ann. and Mag. Nat. Hist.*, vol. ix. 1862. *Journal Linn. Soc.* vol. viii. 1865. Berkeley, *Intell. Observ.* No. x., November, 1862. *Journal Linn. Soc.*, vol. viii. p. 135, 1865. *Quart. Journal Micr. Sc.*, New Series, vol. xiv. 1874. *Nature*, November 9, 1876. Bristowe, *Trans. Path. Soc.*, vol. xxii. 1871. Hogg —, *Monthly Micr. Journal*, August, 1871, March, 1872. Lewis and Cunningham, *Eleventh Ann. Report* of Sanitary Commissioner with the Government of India, 1875. *Indian Annals of Med. Sc.*, vol. xviii. 1876 (Reprint). Tilbury Fox and Farquhar, *On certain Endemic Skin and other Diseases of India*, &c., 1876.

subcutaneous tissue, between healthy fat-lobules; others occupy the interior of the bones; and a third series are developed in the pads of fat lying around muscles and tendons. The muscles and tendons in such cases may frequently be found quite intact, although surrounded by masses of the morbid material. Due to this persistence, fracture and crushing of the softened bones often occurs, and it is on this that the distortion of the affected part is in many cases in great measure dependent.

Minute characters of the morbid products.—The roe-like particles are composed of a nucleus of granular, waxy consistence, surrounded by a fringe of radiating crystals. They appear to be almost entirely composed of fatty matter, and no traces of the presence of parasitic organisms of any kind can be detected in them. The bright red particles occurring in certain cases of the ochroid form are concretions, consisting in great part of phosphates and carbonates, and containing a considerable proportion of iron. The dark masses present in the other form of the disease are of much more complex structure. In all, or almost all, cases they contain septate fungoid filaments in greater or less proportion. These are sometimes difficult to distinguish, but may generally be detected by allowing portions of the material to soak for some days in liquor potassæ. The proportion which the filaments bear to the entire mass when thus separated, is in any case very small, and in some cases extremely so, for on the completion of the soaking only a very small quantity of colourless flocculi, consisting of masses of branched filaments mixed with empty cyst-like cells, is left behind in the fluid. The latter has assumed a brown colour from the solution of the dark mass. The filaments and cysts (*see* the accompanying figure) in so far as tests

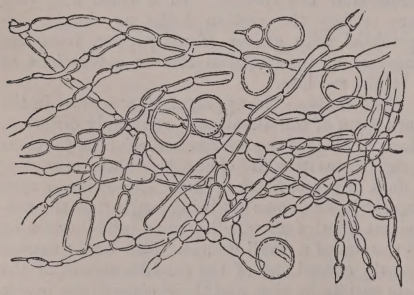

Fig. 21.—Fungoid Filaments and Capsules obtained after prolonged maceration of the black substance in caustic potash. × 500.

have yet determined, are indistinguishable from undoubted fungal elements. They are, as a rule, quite empty, and show no signs of growth, or indeed of life. The basis in which they are imbedded varies greatly in different cases. In some instances it is soft and contains much oily matter, but in the more advanced cases this is almost absent. It is then only soluble by means of alkalis. The ash consists mainly of calcium phosphate and is red, due to the presence of oxide of iron.

The fungoid filaments have never yet been shown to be capable of any further development. All attempts at cultivation have failed in causing them to assume any form by which their true nature and relationships may be determined. They have never given any unequivocal signs of life external to the body, even when exposed to conditions favourable to the growth of fungi as demonstrated by the development of various extraneous moulds upon the surface of the black masses themselves, or on the media in which they were immersed.

Symptoms.—Dr. Carter writes: 'As a rule the local indications of this disease are the same for all its forms; for commonly it is not possible to discriminate the several varieties by simple inspection or bare clinical history of the case.' The statements made by the patients as to the mode of origin and progress of these complaints are very various, but, taken generally, they seem to imply that the symptoms are analogous to those usually observed in deep-seated disease of the osseous and adjoining tissues. Eventually a more or less hard lump is felt in the sole of the foot or palm of the hand, or in several places. Generally one or more abscess-like formations occur, and ultimately several sinuses are established, the latter, as a rule, presenting a peculiar mamillated appearance—the 'tubercles,' apparently, of earlier writers. Along with these changes, enlargement and distortion of the affected member take place, but unaccompanied with severe pain. Discharges set in, more or less offensive, according to the nature of the subjacent degeneration, and the limb becomes not only useless, but a burden to its owner. In this manner the sufferer may go on for from one to fifteen or more years, unless relief be sought in a surgical operation.

Pathology.—The occurrence of the fungoid filaments in the products of the dark variety of the disease, has caused many authors to regard them as the essential cause of it. There are, however, good grounds for rejecting such a conclusion. Had the dark form of the disease been the only one with which we were acquainted, there might have been some cause to regard it as due to parasitic agency. When, however, we find that the pale form, whilst causing all the important lesions present in the other, shows a total absence of all fungoid elements in its products, we are forced to regard such elements as of secondary importance. The only means of overcoming this objection would be a demonstration that the products of the pale form are due to a degeneration of the black matter, in the course of which the fungoid elements disappear. No such demonstration has been given, and, on the contrary, it has been shown that each form is capable of running an entirely independent course, the gradual transformation of the normal fat having been traced in the one case to the production of the roe-like particles, and in the other to that of the black masses in which the fungoid elements are imbedded. Were the pale form the only one known the disease might be described as a mere degeneration of the fatty tissues, with the results consequent on the presence of the morbid products of the process in the surrounding parts; but this explanation, although so far applicable to the dark form, throws no light on the source of

the fungoid elements. They are present in masses which are entirely isolated in the tissues, having no communication with one another or with the exterior. There is no evidence of their passage from one cavity to another—on the contrary they are absolutely limited to the contents of the cavities, the membranous walls of the latter and the intervening tissues never showing any traces of a spreading mycelium, or of any other fungal elements.

Assuming the filaments to be of undoubted fungal origin, the facts point rather to their simultaneous and independent development in multiple centres, than to their spread from one to another. The fact of the necessity of a suitable soil or nidus, in addition to the mere presence of germs, in order to secure the development of organisms, is generally accepted. That germs of most various kinds must constantly be introduced into the blood, is a self-evident fact. Putting their introduction by means of the lungs out of the question, their constant introduction from the intestinal canal can hardly be denied. It can be demonstrated that the intestinal contents abound in vegetable organisms—spores, bacteria, &c.—in a living condition. As it is an ascertained fact that solid particles of inorganic matter of far larger size than many of these germs can enter the circulation, it can hardly be denied that the latter may, and indeed must, enter also. So long as such bodies do not meet with conditions favourable to development, they are no doubt destroyed and utilised by the living matter of the blood and other tissues. If, however, they are deposited in a medium favourable to them, they will grow and undergo such development as they are capable of. The morbid products of the disease here described are practically dead material, external and extraneous to the body, and it has been experimentally demonstrated that when removed from the body they form a basis capable of supporting the growth of fungal organisms. Given these two conditions —the constant presence of germs in the circulation, and the possession of a suitable soil for fungi—and the difficulty of accounting for the presence of fungal elements in the latter appears in great part to disappear.

Prognosis.—Both forms of the disease run a very chronic course, and often without very materially affecting the general health of the patient; in some cases, however, great emaciation accompanies the disease. With regard to the duration of the malady, it may be stated that cases have been recorded as having existed for various periods up to twenty-six and thirty years.

Treatment.—There are no instances recorded of a spontaneous cure having been effected, nor have remedial applications proved of material permanent value in either form of the disease. Removal of all the diseased tissue, by amputation of the affected extremity, is the only remedy which meets with general approval. The subsequent treatment resolves itself into that of an ordinary surgical operation.

D. D. Cunningham.
T. R. Lewis.

FUNGUS HÆMATODES (*fungus*, a mushroom; *αἷμα*, blood, and *εἶδος*, like).—A synonym for soft malignant growths, which are exuberant and highly vascular, and therefore peculiarly liable to bleed. *See* Cancer, and Tumours.

FURFUR.—Synon.: Scurf, Dandruff.—A branlike desquamation of the skin, met with in several cutaneous diseases, more especially pityriasis, psoriasis, and ichthyosis. *See* Skin, Diseases of.

FURFURACEOUS (*furfur*, bran).—A term applied to a condition in which the epidermis is shed in the form of bran-like scales. *See* Furfur.

FURUNCULUS (*fervio*, I boil).—A synonym for boil. *See* Boil.

G

GADFLY.—The popular name for a genus of insects whose larvæ infest man and the lower animals. *See* Œstrus.

GALACTAGOGUES (*γάλα*, milk, and *ἄγω*, I move).

Definition.—Agencies which increase the secretion of the mammary gland.

Enumeration.—The most common galactagogues are:—Mental Emotions; Local Nervous Stimulation; Warmth; good Food; Alcohol; Jaborandi; the fresh leaves of the Castor Oil plant; Tonics; and Electricity.

Action.—When we consider how powerfully mental processes may affect the activity of nerves supplying the secreting structure of glands, we can understand how these may influence the secretion of milk, as of the sweat, the saliva, and the tears. The maternal feelings of joy, as well as the reflex stimulation of the infant's lips, act most rapidly in developing the functions of the breast. Warmth and good diet also play their part in the process. Alcohol in the form of malt liquors, or malt-extract, is a useful adjunct; and so are such tonics as iron, which counteract in some measure the severe drain on the constitutional resources. Little use has yet been made in actual practice of those drugs which are specially credited with galactagogue properties; but we are told on good authority that a poultice made of the fresh leaves of the castor-oil plant, aided by teaspoonful doses of a fluid extract prepared from the

same, have a markedly stimulating influence on the mammary secretion. Belladonna is well known to dry up the milk; and jaborandi, which is its antagonist in so many respects, has been shown to have here also a directly opposite effect, and to be a drug of which further use may yet be made when we wish to excite or re-establish the proper functions of the mammary gland.

ROBERT FARQUHARSON.

GALACTIDROSIS (γάλα, milk, and ἱδρῶς, perspiration).—A term signifying milky perspiration. *See* PERSPIRATION, Disorders of.

GALACTORRHŒA (γάλα, milk, and ῥέω, I flow).—An excessive flow of milk. *See* LACTATION, Disorders of.

GALL-BLADDER AND GALL-DUCTS, Diseases of.—These affections may be considered in the following order:—

1. **Catarrh of the Bile-passages.**—This disease very rarely gives opportunities for examination after death. At the time after death that it is customary to make post-mortem examinations in this country, all redness of the duct has usually disappeared; and there are left only swelling and pallor of the mucous membrane, which is covered with a tenacious glassy or purulent secretion. By this swelling and secretion, the bore of the duct is often greatly narrowed; and it can be seen that no bile has passed over it for some days, as all colour has disappeared from the affected part of the tube. In judging of this, however, no pressure must have been made upon the gall-bladder during the earlier part of the examination. These appearances are most pronounced in the common duct and the gall-bladder; they are gradually lost in the hepatic duct and its branches in the liver. The process seems most intense at the duodenal end of the gall-duct, and the orifice of the papilla itself is often found plugged by mucus, an appearance which certainly favours the notion that the catarrh is propagated from the stomach and duodenum. This is believed to be the commonest source of catarrh of the bile-ducts. It is also seen in nutmeg-liver and cirrhosis; and a tendency to chronic catarrh is set up by the presence of foreign bodies in the ducts, such as gall-stones.

SYMPTOMS.—Jaundice is often the first symptom which draws the attention of the patient to his health in a case of catarrh of the bile-ducts, although in a certain number of cases this is preceded by symptoms of gastric disorder, such as vomiting or sense of sickness, loss of appetite, and furred tongue; or, on the other hand, by diarrhœa. The jaundice lasts about three weeks, sometimes as much as six or eight weeks. After this, suspicion should be aroused whether something more than a simple catarrh be not present.

DIAGNOSIS.—The diagnosis depends upon the absence of any physical signs indicating organic change in the liver; and on the presence of gastric symptoms. Thus nearly all cases of simple jaundice are diagnosticated by some physicians as cases of catarrh of the bile-ducts. As the greater number of the patients recover, very few opportunities are given for verifying this diagnosis; but in those which have been examined, plugs of mucus in the ducts have not unfrequently been found. The catarrh caused by gall-stones is lost in the jaundice and pain associated therewith.

TREATMENT.—The treatment should at first be directed to the gastric symptoms, beginning with a purgative, followed by a course of effervescing alkaline medicines, and restricted diet. Later on, dilute nitro-hydrochloric acid taken before meals is often very useful.

2. **Inflammation and its Results.**—In some cases of typhus and typhoid fever, and in other typhoid states, the gall-ducts and gall-bladder become *ulcerated*, or filled with purulent fluid, or covered with *croupous exudation*. The same thing may happen when gall-stones are impacted in the ducts. The gall-ducts are sometimes *obliterated* by fibrous bands passing over them. Sometimes they suffer a congenital obliteration by the overgrowth of the fibrous tissue around them.

3. **Dilatation.**—The gall-ducts and gall-bladder become dilated whenever there exists an obstruction, either pressing on the ducts from the outside, or formed within them. The first result is dilatation of the ducts behind the obstruction. The gall-bladder becomes much dilated, often filled with a thick green bile. If the obstruction last long, the coloured part of the bile is absorbed, and its place taken by a colourless fluid, either viscid or limpid. This fluid contains neither bile-pigment nor bile-acids, is often albuminous, and contains abundance of mucus. The ducts outside the liver may be enormously distended. It is common to see them as big as the middle finger. Within the liver they are also dilated, but not to so great a degree; and they are more dilated on the left than on the right side. The dilatation of the ducts may become cystic, and sometimes moniliform. The writer has always been able to find columnar epithelium in these dilated ducts. In some cases of long-continued obstruction, the contents of the bile-ducts become colourless; in other cases, purulent; and small abscesses form around the bile-ducts, and open into them. These abscesses may be multiple; or, more commonly, only a single large one is formed. The abscess or the dilated gall-ducts may rupture into the peritoneum, and cause fatal peritonitis.

4. **Cancer.**—Primary cancer of the gall-ducts and gall-bladder is sometimes met with; or they may be affected secondarily.

5. **Foreign bodies** are occasionally met with in the gall-ducts. The most common of all are, of course, *gall-stones*. Much less common are entozoa, such as the *Distoma hepaticum*, *hydatids*, or the two kinds of *ascarides*.

SYMPTOMS.—In all these different morbid states, it is usually only possible to say at the bedside that the large bile-ducts are obstructed; a more complete diagnosis is commonly impossible. Jaundice is an important symptom, as without it disease of the bile-ducts cannot be diagnosticated. It is commonly very intense, the urine being deeply coloured, and the fæces quite colourless. The enlargement of the liver, if present, is commonly uniform, the surface being smooth, and the edges well-defined. The gall-bladder may often be felt at the edge of the right lobe as a rounded tumour; this is

then a sure sign of the obstruction of the gall-ducts. In simple diseases of the gall-ducts there is an absence of splenic tumour, of ascites, and of other symptoms of portal obstruction. In many cases, however, diseases of the liver and of the gall-ducts are so intimately bound up together, that they cannot, during life, be separated.

Prognosis.—The prognosis, if simple catarrh of the gall-ducts and gall-stones can be excluded, is unfavourable.

Treatment.—The treatment must be conducted on general principles.

6. Enlargement of the Gall-bladder.—The gall-bladder cannot be felt in health during life. But it may often readily enough be made out where there exists any obstruction in the common or cystic duct, so that it becomes distended with fluid. It may also be felt when the walls become fibrous or calcified, or the seat of cancer; or when its cavity is filled with gall-stones. A tumour may then be felt under the border of the right lobe of the liver, in the situation of the gall-bladder. When filled with fluid, a rounded, sometimes oblong, sometimes pear-shaped tumour is felt; in other cases it has an irregular shape, or a somewhat rounded outline. A greatly-distended gall-bladder has been mistaken for ascites, and tapped. The diagnosis depends chiefly on the situation of the swelling, and even then the distended gall-bladder may be mistaken for hydatid-disease of the liver-substance or of the omentum, or for a tumour of a neighbouring organ which has pressed against the liver. The difficulty of the diagnosis is much increased if the liver be moved from its natural place, for then the position of the gall-bladder becomes uncertain. Bamberger says he has often mistaken a softened cancerous nodule of the liver for a distended gall-bladder. If it be certain that a fluctuating tumour be the gall-bladder, and no jaundice be present, a diagnosis may safely be made of hydrops cystidis felleæ, or dropsy of the gall-bladder; but if jaundice be present, or if the tumour do not fluctuate but appear solid, there are then no definite rules for diagnosis; all depends upon the surrounding facts of the case. Dropsy of the gall-bladder is not a dangerous disorder, and requires no treatment; while the prognosis and treatment of the other states depend entirely on their respective causes.

7. Perforation.—Perforation of the gall-bladder or of the gall-ducts is generally the result of ulceration, due to gall-stones, inflammation, and other causes. Fatal peritonitis ensues if the perforation occur into the abdominal cavity. Frequently, however, previous adhesions have been formed between the biliary reservoir or duct, and the neighbouring organs or the abdominal wall, and the result of this is—

8. Biliary Fistula.—This may exist between the gall-bladder or gall-ducts and the surface of the body, the stomach, colon, or duodenum. Very rarely gall-stones find their way into the urinary tract.

J. Wickham Legg.

GALL-STONES.—Synon.: Hepatic Calculi; Cholelithiasis; Fr. *Calculs biliaires*; Ger. *Gallensteine.*

Description.—Gall-stones are seen in man and most of the vertebrate animals, and in some molluscs. They are especially common in oxen. They are found in the biliary passages; most usually in the gall-bladder, or the cystic and common duct; more rarely in the hepatic duct, and in its branches within the liver. They vary in size from fine gravel to concretions five inches long. The largest are commonly single, and then they are rounded or oval in shape. The smaller calculi are usually numerous, being then tetrahedral or wedge-shaped, showing the facets or plane surfaces caused by mutual pressure. They are never lighter than water when first removed from the body. Only after drying do they float. Their consistence when raised to the ordinary temperature of the body becomes much less, so that they can be moulded by the fingers. Their colour varies from white to almost black; most commonly it is brown.

Dr. Thudichum thinks that the nuclei of gall-stones are mostly formed of casts of the hepatic ducts. There is rarely more than one nucleus. Its chemical composition is a compound of lime and bile-pigment, or traces of mucus and phosphatic earths. The chief chemical constituent of human gall-stones is cholesterin; some gall-stones are wholly composed of this substance; most contain 70 or 80 per cent. Other constituents of gall-stones are the bile-pigments, either by themselves, or in combination with lime. Very small quantities of the bile-acids are found, and these are also in combination with lime. It is rare to find gall-stones with any large amounts of carbonate or phosphate of lime, though the ash of nearly all gall-stones shows a large amount of carbonate of lime, the product of the combustion. Traces of copper, iron, and manganese are found in nearly all gall-stones. Lime-salts of the fatty acids are likewise found.

Ætiology.—Age has a very great influence in the production of gall-stones; they are exceedingly rare in infancy and childhood, their frequency increases after the age of puberty, and they become still more common after thirty. Women are thought to be more liable than men to gall-stones. In cancer of the liver, gall-stones are certainly very commonly found, while on the other hand in cirrhosis they are scarcely ever seen. Want of physical exercise and indulgence in rich diet seem to favour their production.

Pathology.—What is the cause of the first formation of a gall-stone? It is not simply concentration of the bile, since the cholesterin and pigment remain in solution so long as the bile is unchanged; but the beginning of decomposition of the bile-acids causes a precipitation. The cholesterin is likewise thrown down when the reaction of the bile changes from alkaline to acid. Gorup-Besanez and Dr. Thudichum have kept bile several months, and found the reaction at the end of that time acid, with an abundant sediment. It is thus probable that the retention of bile in the gall-bladder or gall-ducts favours the growth of these concretions. It is also probable that gall-stones are sometimes dissolved spontaneously, as erosions may sometimes be seen on them; or they may break up, and thus pass out.

Symptoms.—Gall-stones while still in the gall-bladder rarely give any signs of their

presence. They are frequently found in the gall-bladders of persons who during life had no symptoms which could be referred to the liver. It is when they begin to leave the gall-bladder, and escape into the cystic and common duct, that symptoms arise of gall-stone colic. They often begin with a dull pain near the liver, with vomiting, rigors, and elevation of temperature; or, quite suddenly, a severe pain in the right hypochondrium comes on, described as shooting, stabbing, burning, &c. The pain extends into the epigastrium, rarely to the left hypochondrium, to the right shoulder, and, according to some, even into the extremities. The pain is very intense, and may give rise to delirium and convulsions in nervous persons, or to hysterical attacks in women. Vomiting is usually present; and, as the attacks most often come on after eating, at first only the food taken is thrown up, and then a colourless mucus. The right hypochondrium is usually very tender, and the muscles are rigid. The pulse is not increased in frequency, being indeed rather below than above the natural number. In violent attacks the pulse becomes very frequent and small, or almost imperceptible; the eyes are surrounded with dark marks; the nose is pointed; the breath is cool; and cold sweats break out over the body. In this state death may occur, but it is a rare event. A few hours after the attack, the conjunctivæ may show a yellow tinge, which will gradually spread from the upper part of the trunk all over the body. The jaundice is more or less intense according to the shape of the gall-stone—whether completely obstructing the duct, or merely causing a hindrance to the passage of the bile. In some cases jaundice may be altogether wanting, as when the stone is in the cystic duct. The jaundice may last an indefinite time. The duration of the attack of colic itself varies; usually not lasting more than a few hours, it may extend over several days. As soon as the gall-stone reaches the duodenum the attacks are over, the stools become dark, and the jaundice begins to disappear. When the gall-stones reach the intestine, they are commonly evacuated with the fæces; some cases have, however, been recorded in which they were so large that symptoms of intestinal obstruction were caused and death resulted.

Diagnosis.—The diagnosis of gall-stones is often more or less difficult. Some physicians think that the diagnosis should not be made unless the concretions be found in the stools; and the search for them should be made by passing the fæces through a sieve. It is agreed by nearly all that it cannot be made if there be no jaundice present. Cancer of the head of the pancreas may readily be mistaken for gall-stones in the common duct.

Prognosis.—It is almost impossible to make a trustworthy prognosis in these cases. The physician can never speak confidently, or feel quite happy when treating a case which he looks upon as one of gall-stones.

Treatment.—The treatment of gall-stones may be discussed under two heads: during the paroxysm of the colic; and between the attacks.

During the paroxysm, the great object of the physician is to relieve the pain. This may best be done by full doses of morphia; and if this be rejected by vomiting, it may be administered hypodermically. The patient may be put in a warm bath and kept there, the heat being maintained by the renewal of the warm water. Should these means fail, chloroform or ether may be inhaled.

Between the attacks of biliary colic a great number of remedies have been proposed: the most popular is Durande's, which consists of three parts of ether and two parts of turpentine: the best plan is to give 10 to 20 minims of this mixture three times a day, enclosed in capsules or pearls. The German physicians have great confidence in the alkaline mineral waters, especially Carlsbad. Some think this due simply to the large amount of water daily ingested, causing a large flow of bile. Others recommend purgatives, as castor oil, or taraxacum; or aqua regia. Emetics have been employed, but they are dangerous on account of the straining which they cause, and which may lead to the rupture of a vessel.

J. Wickham Legg.

GALLOPING CONSUMPTION. — A popular name for phthisis when it runs an acute or rapid course. *See* Phthisis.

GALVANISM, Uses of. *See* Electricity.

GANGLION (*γαγγλιὸν*, a hard gathering). This term is applied to a variety of somewhat different affections, including:—1. The *simple* ganglion. This is a cystic tumour formed in connection with the sheath of a tendon. 2. The *compound* or *diffuse* ganglion, which consists of a chronic effusion into the common sheath of a group of tendons, giving rise to a fluctuating swelling. One variety of this contains the so-called melon-seed bodies. 3. The term is extended by some writers to enlargements of the bursæ mucosæ. *See* Bursæ, Diseases of.

1. **Simple Ganglion.**—Description.—The simple ganglion forms a rounded tumour, occasionally lobulated, situated in the immediate neighbourhood of some tendon. The most common situations are the dorsum of the hand, the dorsum of the foot, the palm of the hand at the root of a finger, and behind the outer or inner malleolus. The tumour varies in size from a pea to a pigeon's egg. It may fluctuate distinctly, or be so tense as to seem absolutely solid. It is not adherent to the skin or to the tendon with which it is in relation. It is painless, but often gives rise to a sense of weakness in the affected part. The wall is composed of a more or less delicate fibrous tissue, fusing with the surrounding areolar tissue, and lined by an imperfect layer of endothelial cells. Its contents are most usually semi-solid, like apple-jelly, but sometimes fluid. They are said to be neither albuminous nor gelatinous, but colloid in character. As to the exact nature of the tumour opinions differ, and probably it is not always the same. It is said to arise in the following ways: 1st. by a hernial protrusion from the sheath of a tendon, the neck of which becomes gradually contracted and finally closed, so giving rise to a cyst in intimate connection with the sheath. 2nd. Gosselin has described small follicles or sub-synovial crypts, which he believes may become dilated, so as to

form ganglia. 3rd. The tumour may be a cyst of entirely new formation.

Treatment.—Painting with iodine is of little or no use. Forcible rupture of the cyst by a blow or pressure sometimes effects a cure; but the best treatment is to puncture the tumour with a clean grooved needle, and to squeeze out the contents, afterwards applying pressure or a blister over the collapsed cyst. This treatment may require to be repeated more than once.

2. **Compound or Diffuse Ganglion.**—Description.—This disease is almost exclusively confined to the sheath of the common flexors of the fingers. It may consist of a simple dropsy of this sheath, forming an hour-glass-shaped swelling in the front of the wrist, the constriction being caused by the annular ligament; or, in other cases, the tumour may contain melon-seed bodies, which give rise to a sense of soft crackling when it is manipulated. These melon-seed bodies are smooth, oval and flattish in shape, and of a pearly-white colour. They are of almost cartilaginous toughness, and on section present an appearance of concentric lamination. Under the microscope they are found to be composed of very imperfect fibroid tissue. Their origin is somewhat doubtful. They have been supposed to be due, first, to hypertrophy of the fringes, normally found on a synovial membrane, the pedunculated projections so formed being ultimately broken loose by the movement of the tendons; secondly, to the formation of pedunculated warty outgrowths on the synovial membrane, which become free in the same way; thirdly, to fibrinous deposits taking place from the fluid in the ganglion; and, fourthly, to the results of accidental hæmorrhage. When these bodies are abundant, the fluid is usually scanty.

Ætiology.—The cause of this affection is uncertain, but it must be remembered that in many cases it is due to the irritation caused by the earliest stage of disease of the carpus.

Treatment.—The treatment of compound ganglion is unsatisfactory. Iodine is useless. Aspiration followed by the injection of iodine has occasionally been of service. An incision made into each end of the tumour, followed by drainage under antiseptic dressing, is often of use. In extreme cases Syme recommended laying the whole cyst open, and allowing it to granulate. This always left much stiffness in the tendons. When melon-seed bodies are present, they must be removed by incision, and the case treated antiseptically. Marcus Beck.

GANGLIONIC NERVOUS SYSTEM, Diseases of. *See* Sympathetic Nerve, Diseases of.

GANGRENE (*γραίνω*, I corrode).—Synon.: Mortification; Sphacelus; Fr. *Gangrène*; Ger. *der Brand.*

Definition.—Gangrene is the arrest of the functions of organic life in a circumscribed portion of the soft parts of the body, leading to the complete death of the same.

The whole process of death is included under the term gangrene—the result being mortification, or necrosis of the invaded tissue, organ, or limb.

Classification.—*Clinically*, gangrene varies greatly according to its position, cause, extent, the powers of the patient, and the existence of complications. The disease may also be classified *ætiologically* and *pathologically*, into *spontaneous* or *traumatic*, *dry* or *moist*, *chronic* or *acute gangrene*, *senile gangrene*, and *hospital gangrene*. The division into dry and moist gangrene, although convenient, has little pathological significance, being founded on physical characters. Both dry and moist gangrene may arise from similar causes, and coexist even, in different parts of the invaded structures; and it cannot always be predetermined whether a gangrene shall be of the dry or of the moist form. Dry gangrene is usually dependent on senile changes, limited in extent, and chronic in progress; the parts first affected having time to dry up as the disease invades those adjacent, and becoming mummified, hard, and black, resembling the knuckle of a Spanish ham. Moist gangrene occurs when a larger area of living tissue suddenly mortifies, and especially if it have been previously inflamed or gorged with fluid; the dead parts becoming rapidly transformed into a deliquescent putrid mass, infiltrated with gas. To this type belong many different forms of gangrene, for instance, that following the obliteration of the main artery of a limb by a ligature, or its becoming plugged by an embolus, or the form called *spreading traumatic gangrene*, or gangrene affecting an internal organ.

Ætiology.—The causes of gangrene may be local, constitutional, or a combination of both. Amongst *local* causes we find intense inflammation of some organ or tissue, such as pneumonia, noma, cellulitis, anthrax, or phlegmonous erysipelas. Injuries and mechanical violence of various kinds; and extremes of heat or cold, as seen in burns and scalds or in frostbite, also lead to gangrene. Gangrene may be produced either as the direct consequence of the long-continued application of cold, or as the result of the subsequent inflammatory reaction. Local arrest of the circulation, as in a strangulated hernia, an intussusception, or internal strangulation, a ligatured hæmorrhoid, a too tightly bandaged limb, or severe paraphimosis, may lead to gangrene. It may also occur from extravasation of urine or fæces. Continued pressure produces a variety of gangrene called *bedsore*, especially in lowly vitalised parts, and in persons suffering from chronic diseases, or from certain lesions of the nervous centres. *See* Ulcer and Ulceration.

One of the most frequent *constitutional* or *general* causes of gangrene is deficient blood-supply, dependent upon disease of the arteries and heart, the result usually of systemic decay, whence the term *senile gangrene*. Gangrene may occur in the course of certain severe diseases, as diabetes, typhus, typhoid, measles, and scarlatina; embolism being in many cases the immediate cause of the complication. The gangrene due to ergotism is probably induced by the effect of the poison on the blood-vessels. A peculiar form of gangrene sometimes met with in the extremities—the *gangrène symétrique* of the French, is one in which no more definite cause can be found than anæmia, and an extremely feeble circulation. And, finally, there is *hospital gangrene*—

pourriture d'hôpital, a disease seldom met with now except amongst wounded soldiers accumulated in great numbers in foul hospitals near a battle-field.

Symptoms.—The symptoms of gangrene vary with the species, the extent, and the stages of the disease, and with the rapidity of its progress; and also according as it is dry or moist, incipient or complete. The importance of the tissue or organ invaded, and the presence or absence of complications, such as renal or cardiac disease, or of fever, also create differences.

The earliest symptoms are those of diminished circulation, sensibility, and temperature, together with change of colour in the part affected. Pain is one of the primary symptoms, and often precedes the others. In dry, senile, or chronic gangrene, there may in some cases be few symptoms beyond moderate local pain and discomfort, though oftentimes the pain is intense; whilst, when the type is of the moist or acute variety, the symptoms are usually more severe, and have a tendency to lapse into those called the typhoid or septicæmic. Between these two forms there is every intermediate grade of severity. The amount of fever varies at the outset, but it is usually considerable. The patient generally suffers much from pain, restlessness, and want of sleep; the appetite is bad; the tongue is loaded; and the pulse is feeble or intermittent. When the disease becomes arrested, the dead portion of tissue slowly separates and drops off, or is removed; very often, however, the disease steadily progresses, and the patient dies from exhaustion, or more rapidly from the absorption of septic matter.

Such being the principal symptoms of gangrene in general, we may next describe the symptoms of the leading varieties of the disease.

Dry or Chronic Senile Gangrene.—In the dry form of senile gangrene the part is gradually starved to death. The disease generally occurs in the toes, very rarely in the fingers; and is either spontaneous or excited by some trivial cause. A discoloured patch appears on one of the toes, of a dusky reddish-brown colour, which soon becomes dry and black in the centre. The disease spreads very slowly to the adjacent parts. First, a zone of discoloration appears from the blood stagnating in them; then they become livid, red, and inflamed; afterwards darker; and, finally, black and dry. One or several toes may be involved, or the foot in whole or in part. The patient generally dies sooner or later, exhausted by pain, and from general feebleness of the vital powers. Sometimes a line of demarcation appears, the dead parts separate, and recovery follows; but as a rule relapses take place.

Moist or Acute Senile Gangrene.—This form of senile gangrene is more active in its progress, and more rapidly fatal. It is often ascribed to some slight local irritation or injury, such as an inflamed corn or nail. The affected toe becomes dusky-red, swollen, and extremely painful; soon after the dark hue of absolutely dead tissue appears, following closely the zone of inflammation; and this gradually spreads onwards till the whole foot or possibly the leg, if the patient survive, becomes implicated. Beyond the gangrenous area the skin is mottled, and presents all the appearances due to impeded circulation. In this type of gangrene, stasis of the blood and coagulation first take place in the capillaries, and extend thence to the smaller arteries. It occurs in elderly persons with feeble circulation, due to fatty heart and atheromatous arteries.

Gangrene from Arterial Obstruction.—The most common form of moist gangrene is that due to sudden arterial obstruction—when the collateral supply cannot establish itself with sufficient rapidity. It is acute, and a large part of the body being at once engaged, the tissues do not, as in dry gangrene, have time to dessicate *pari passu* with the spread of the disease. It may happen after ligature of a main trunk for aneurism; or by the formation of a fibrinous clot upon the roughened wall of an atheromatous vessel, and consequent plugging; or by embolism of some artery. An entire limb may thus be lost. Venous obstruction *per se* does not produce gangrene. In cases due to embolism—a form rare in the upper limbs, but common in the lower extremities, and more especially in the anterior tibial arteries—sudden and severe pain marks the onset of the disease. The temperature of the part rapidly falls; livid discoloration and loss of sensibility ensue; the veins if emptied fill very slowly; the skin mottles; bullæ form filled with turbid fluid; the colour changes from whitish grey to green, olive, or black; and the affected tissue at length becomes a deliquescent putrid mass, often crepitating from gas imprisoned in the meshes of the cellular tissue. The tendons, blood-vessels, and nerves resist the disintegrating process longest.

Gangrene from Inflammation.—Gangrene as the result of intense inflammation is likewise of the moist type. When it supervenes, the tension, pain, and swelling of the inflamed area subside; the part becomes soft and pasty; the colour changes into dusky violet, brown, or black; and all the evidences of rapid decomposition, varying with the part affected, and the acuteness of the inflammation, make their appearance.

Gangrene as a Complication of General Disease.—Gangrene is occasionally met with in the later stages of typhoid fever, or even during convalescence; and usually occurs in the lower limbs, though sometimes in the lungs, or face. It is of vascular origin, and is a most grave complication. In form it may be either dry or moist, and may be of either of two kinds. One is of early occurrence in the progress of the disease, and generally affects the toes symmetrically; the other occurs later, or during convalescence, and is of embolic origin.

Measles is prone in some cases to occasion gangrene, generally affecting the face, the vulva, or the lungs. Scarlatina and some forms of erysipelas are also occasionally followed by extensive gangrene. The disease has been also observed during some epidemics of cholera. Gangrene produced by the prolonged consumption of diseased rye-bread chiefly occurs in the male adult, and very rarely in women or children. Other symptoms of ergotism will then be present, gangrene being a late occurrence. Gangrene from ergotism precisely resembles ordinary senile gangrene. It almost invariably appears in the lower limbs; and when a line of demarcation

forms, this generally seems to correspond with the nearest joint. In diabetic gangrene no special vascular deficiency can be traced. The vitality of the tissues seems impaired by the glycosuric condition, and some slight accidental cause provokes a gangrenous inflammation.

Hospital Gangrene.—Hospital gangrene presupposes a wound: the lesion on invasion, ceases to discharge, and becomes covered with a grey tenacious slough extending from the centre towards the edges, which become much inflamed and everted. The patient rapidly lapses into a typhoid condition; and the issue is generally fatal.

Acute Traumatic or Spreading Gangrene.—This form also follows upon an injury, which may be either slight or severe. It is generally seen in one of the extremities, originating in a wound and rapidly spreading towards the trunk—*Gangrène foudroyante.* It is in many cases intimately associated with, and probably induced by, septic infection of the system. It is usually fatal, and scarcely amenable to treatment.

Visceral Gangrene.—The gangrene of internal organs will be found described in connection with the diseases of the several organs.

Progress.—The progress of gangrene dependent on constitutional causes is too often from bad to worse; and a fatal issue may supervene without any attempt at repair. The gangrenous inflammation, preceding the actual death of the part, continually invades fresh tissues; the fever increases; a sallow sunken countenance, with rapid thready pulse, sordes, muttering delirium, tympanites, hiccough, subsultus, scanty loaded urine or even suppression, supervene; the weakness increases; and death, preceded by collapse, takes place.

In other cases, especially those dependent on local causes, there is a tendency to limitation; and the process by which this is accomplished is the same for all kinds of gangrene, in every part of the body. In superficial structures a red band of healthy inflammation will be observed at the junction of the living with the dead part, called the *line of demarcation*; active cell-infiltration takes place; and a separating wall of fibrin and young cells is established in the layer of living tissue nearest to the dead structures. This becomes by degrees converted into an ordinary granulating surface, and the dead tissue is detached and cast off. The time required for this separation varies with the bulk of the dead portion, the nature of the tissue, and the vitality of the individual. The risk of septicæmic poisoning is present throughout the entire course of the disease.

Diagnosis.—The diagnosis of gangrene of external parts cannot be attended with any difficulty; the evidence of its presence being readily appreciated when the symptoms already described make their appearance.

Prognosis.—The prognosis of a case of gangrene will mainly depend on the likelihood of the disease becoming limited, the strength of the patient, and the conditions in which he is placed; which are all at first difficult to determine. The cause of the gangrene, and the presence or absence of organic mischief elsewhere, also exercise a great influence. When the malady is dependent on a constitutional cause, there will be little tendency to delimitation, and a bad prospect of recovery. When the cause is local, and the destruction of tissue neither extensive nor invading a vital part, the prognosis will be favourable. But a local injury, when the conditions are unfavourable, may be followed by a severe and extensive gangrene, or some essential part of the body may become implicated.

Treatment.—When gangrene is imminent, our first care should be to adopt means to support the vital warmth of the part, and to encourage and relieve the embarrassed circulation. When the disease is fully developed, our attention must be directed to control as far as practicable the spread of the disease; to favour the separation of the dead tissue; and to keep the parts as clean and harmless as possible. We must also anticipate complications, or combat them when they occur; and support the patient's strength by good food, stimulants, and fresh air, together with opiates sufficient to allay pain. A limited traumatic gangrene is to be treated as an ordinary sloughing wound. If a complete portion of a limb be involved amputation should be performed, as soon as the line of demarcation is established. In gangrene due to arterial obstruction the extremity should be raised to assist the return of venous blood; antiseptic dressings and cotton-wool applied locally; and plenty of bland food administered at frequent intervals. When the whole limb is affected, nature may be assisted by completing the amputation of the part as soon as the limiting line is distinct. In gangrene caused by the ligature or rupture of a main artery, or the pressure of an aneurism, amputation close to the seat of the lesion may at once be performed, as the gangrene cannot extend higher than this point; but even under these circumstances it will often be safer to await indications of a commencing demarcation and then to amputate close to it. In spreading traumatic gangrene early amputation of the affected limb has been strongly recommended; but as this cannot remove the already poisoned condition of the blood, upon which in all probability the gangrene depends, it is clearly a useless measure, as the gangrenous action would invade the stump. In cases where traumatic gangrene is localised and dependent merely upon the violence of the injury, the vitality of the individual will be sufficient to overcome the mischief, unless it be very extensive. A line of demarcation will appear, and then, but not before, will it be proper to amputate, unless the part be otherwise hopelessly injured, or a large articulation opened, when immediate amputation is indicated. For the treatment of gangrene occurring in internal organs the reader is referred to the articles on diseases of the several viscera.

William Mac Cormac.

GARGLE (γαργαρίζω, I wash the throat).—Synon.: Fr. *Gargarisme*; Ger. *Gurgelmittel.*

Definition. — Gargles are liquids employed for the production of local effects on the throat and pharynx.

Mode of Gargling.—This consists in taking about a table-spoonful, more or less, of the gargle into the mouth, throwing back the head, and agitating the liquid by the air expelled through the larynx. With some persons the gargle goes

little beyond the uvula and base of the tongue; but if the head be thrown well back, the fluid can be made to pass into the cavity of the pharynx, and may even reach the larynx and vocal cords. The tension of the muscles, in thus throwing back the head, is apt to provoke efforts at deglutition, so that sometimes small portions of the gargle may be swallowed; and occasionally the effort terminates abruptly in the patient jerking his head forwards, and expelling the gargle forcibly through the nose.

Dr. H. Guinier of Cauterets has demonstrated a method of gargling the laryngeal cavity. His instructions are as follows:—1. Slightly to raise the head; 2. To open the mouth moderately; 3. To protrude the chin and lower jaw; 4. To emit the sound of the double vowel *œ*. These four movements open largely the back of the mouth, lift the velum palati and uvula, separate the base of the tongue from the posterior wall, and allow the liquid used for gargling to gravitate into the cavity of the larynx. One expiratory act is the only respiratory movement that is now possible, deglutition is under control, and the gargle bathes the pharynx and supraglottic portion of the larynx.

Uses and Composition.—The use of gargles is contra-indicated in parenchymatous inflammations of the tonsils, and in all cases where movement of the fauces causes severe pain; and where, as in some persons, an inability exists to retain liquid beyond the anterior pillars of the fauces, for these it is more convenient to apply the fluid to the fauces and pharynx, either by injection, or in the form of a medicated spray, or else by aid of a brush or sponge.

Gargles vary in composition according to their object. If prescribed with the view of exercising the muscles of the soft palate and pharynx, and thereby increasing their tone, cold or iced water is generally sufficient. If with the view of reducing and allaying local inflammatory conditions of the throat, solutions of chlorate or nitrate of potash or of borax (two drachms to eight ounces), or of liquor ammoniæ acetatis (one part in four), combined with decoctum lini compositum, thin gruel, or water, and used warm, are the best. When it is desirable to excite the mucous membrane and neighbouring glands to further secretion, and thus reduce local congestion, stimulant gargles are useful, such as the tinctures of capsicum (half-drachm to eight ounces), arnica, myrrh, pyrethrum, and eucalyptus rostrata (two drachms to eight ounces); this class of gargles often relieving the deafness caused by obstruction of the Eustachian tubes, by increasing the pharyngeal secretion. To check excessive secretion astringents, in the form of the salts of iron and zinc, iron-alum, or alum (forty grains to eight ounces), tannin (half-drachm to eight ounces), or rhatany infusion, are advisable. If we require to check ulceration, or to dilute and purify foul or putrid secretions from the throat and tonsils, antiseptic gargles, composed of the solutions of permanganate of potash (two drachms to half-a-pint), of chlorinated soda (one drachm to eight ounces), of sulphurous acid (one part in four), or of glycerine of carbolic acid (half-ounce to eight ounces), will answer the purpose. In cases of syphilitic sore-throat, a gargle of perchloride of mercury (three grains to eight ounces) has been recommended. In many cases combinations of different kinds of gargles are beneficial. Water, barley-water, rose or orange-flower-water, sweetened with a little honey, glycerine, or syrup, constitute the bases of most gargles.

John C. Thorowgood.

GASTEIN, in the Austrian Alps. Simple thermal waters. *See* Mineral Waters.

GASTRALGIA (γαστὴρ, the stomach, and ἄλγος, pain).—Synon.: Gastrodynia; Fr. *Gastralgie*; Ger. *Magenschmerz*.

Definition.—Pain in the stomach, which occurs in various gastric disorders, and which, considered by itself, is not much to be relied on as a sign of disease.

Symptoms.—In acute erythematous gastritis a burning, painful sensation affecting the stomach, and not unfrequently extending up the œsophagus, is felt almost immediately after taking food or a stimulant liquid. In acute catarrhal gastritis pain is seldom complained of. In ordinary chronic gastritis it is usually absent; or, at most, only a slight heaviness or fulness after food forms a symptom of the malady. In what the writer has named 'eczema of the stomach' the pain is very severe, comes on two or three hours after food, and is temporarily relieved by eating. The same kind of pain may be observed whenever there is profuse mucous secretion, but it is less severe than in cases where gastric disturbance replaces eruptions of the skin. The pain accompanying pyrosis is of a spasmodic character, and is relieved by the ejection of a tasteless fluid. Severe pain is a common accompaniment of atonic dyspepsia, occurring in nervous or hysterical persons. It comes on when the stomach is empty, but is often aggravated directly after food, and is relieved by the escape of flatus, and by stimulants. The most severe gastralgia is that accompanying ulceration of the stomach. In this disorder it is referred to one spot, and is likewise often felt in the back. The mere fact that a pain in the epigastric region is confined to one small spot should induce the practitioner to view the case with suspicion. The pain in ulceration is usually absent when the stomach is empty, but comes on from two to ten minutes after food. In other instances a longer period, such as half an hour, elapses; but it is this definite relation to the digestive process that makes the pain of ulceration characteristic of the disease. It is usually said that when the pain comes on directly after food the cardiac region is the seat of the ulcer, and where a longer interval takes place the sore will be found near the pylorus. This, if true as a general rule, is, nevertheless, open to many exceptions; for, as a patient observed, the pain occurred later after taking food in proportion as she improved in health, and the first evidence of a relapse was the shortness of the interval of ease after eating. In cancer the pain is more continuous than in simple ulcer; it is less influenced by the digestive process, and is more diffused. It is, however, no uncommon circumstance to find cancer of the stomach without any complaint of pain. The softer kinds of malignant growth seem to the writer least apt to

cause suffering, probably because the peritoneum is less liable in such cases, than in the other forms, to be affected with inflammatory action. Neuralgia of the stomach is a favourite disease with some authors. There is no doubt that the normal sensibility of the stomach is vastly exaggerated under some conditions, but the writer's observation leads him to believe that neuralgic pain affecting the stomach, *independently of other disease*, is a much rarer complaint than is generally supposed (*see* STOMACH, Diseases of). The writer has met with three different forms of pain in the region of the stomach ascribed to neuralgia, which are evidently of a different nature—1. Where severe pain has come on at some period of the day at a certain hour, at a considerable period after the commencement of digestion. In many of these cases it has been evident on inquiry that the apparent periodicity was the result of the punctual disposal of the chief meal of the day. They were, in fact, cases of chronic catarrhal gastritis attended with considerable secretion; most of them occurred in gouty men, and might be classed under the head of eczema, rather than of neuralgia of the stomach. 2. Cases such as the following:—A young lady had suffered for many months from agonising pain in the left hypochondrium, coming on at each menstrual period, and resisting all methods of treatment. In this and other similar cases, it will be found that the seat of the pain is really external, in the intercostal nerve, and not in the stomach itself. 3. Severe attacks of pain in the left hypochondrium and epigastrium in females of a nervous temperament, who had either been born, or had passed most of their lives, in tropical countries. The real seat of the pain in such cases appears to be the colon; there is always constipation; and a mild aperient and tonic treatment is usually effectual in removing or ameliorating the complaint. S. FENWICK.

GASTRIC FEVER (γαστὴρ, the stomach). A popular name for a febrile condition attended with prominent gastric symptoms; as well as for typhoid fever. *See* TYPHOID FEVER.

GASTRIC GLANDS, Diseases of (γαστὴρ, the stomach). *See* STOMACH, Diseases of.

GASTRIC ULCER (γαστὴρ, the stomach). *See* STOMACH, Diseases of.

GASTRITIS (γαστὴρ, the stomach).—Inflammation of the stomach. *See* STOMACH, Diseases of.

GASTRODYNIA (γαστὴρ, the stomach, and ὀδύνη, pain).—A painful affection of the stomach, generally considered as of a neuralgic character. *See* GASTRALGIA.

GASTRO-ENTERIC (γαστὴρ, the stomach, and ἔντερον, the intestine).—This term is applied to those morbid states in which the stomach and the intestine are simultaneously affected. The continuity and similarity in structure of these viscera render them peculiarly liable to coincident disease; and this is more particularly noticed in affections of an inflammatory type (gastro-enteritis), or of a degenerative nature. At the same time, as gastritis may occur and run its course without giving any indication that the intestine is involved, so enteritis may be developed with little or no disorder of the stomach. The same causes appear to determine similar diseases in the stomach and in the intestine; but why at one time both should suffer, and at another time one should escape, is not known. Occasionally it would seem that the entire alimentary canal beyond the œsophagus is attacked at once, and the gastro-intestinal catarrh of children is a good example of this. Sometimes the disorder commences in one part of the canal, and spreads until both the stomach and the intestine are involved. *See* INTESTINES, Diseases of; and STOMACH, Diseases of. W. H. ALLCHIN.

GASTRORRHŒA (γαστὴρ, the stomach, and ῥέω, I flow).—An excessive flow of mucus from the lining membrane of the stomach, due to catarrh. *See* STOMACH, Diseases of.

GELATINIFORM CANCER.—A synonym for colloid cancer. *See* CANCER.

GENERAL.—This word, as employed in relation to medicine, has several applications. Thus we speak of a *general disease*, which is a disease affecting the whole system, as distinguished from a local affection. As further examples may be mentioned *general debility*, *general paralysis*, and *general dropsy*. So, with respect to therapeutics, *general treatment* refers to remedial measures intended to affect the organism as a whole. In connexion with the sciences of therapeutics, pathology, &c., the word *general* is intended to express the essential principles of these sciences, as distinguished from their special divisions.

GENERAL PARALYSIS OF THE INSANE.—SYNON.: General Paresis; Fr. *Paralysie générale incomplète*; *Périencéphalite chronique diffuse*; Ger. *Allgemeine progressive Gehirnlähmung*; *Paralytischer Blödsinn*.

DEFINITION.—A gradual loss of the power of coördinated movement, accompanied by gradually increasing mental disturbance and decay.

ÆTIOLOGY.—The subjects of general paralysis are most frequently of the male sex, and between 30 and 50 years of age. It may be brought on by excessive mental labour, by severe anxiety, by alcoholic or venereal excess, or by any prolonged strain upon the mental organisation. It may also be induced by a blow or other direct injury to the head. Hereditary predisposition is probably not without influence upon its production; but this is not so frequently present as in most other forms of insanity. The disease most frequently attacks persons who have previously been apparently in the enjoyment of vigorous health.

ANATOMICAL CHARACTERS.—Authorities are not agreed upon the precise nature of the pathological changes characteristic of this disease. The most frequently described lesions are congestion and thickening of the membranes of the brain; and degeneration of the cortical substance, shown by a fatty or shrunken condition of the nerve-cells, and an augmentation of the connective tissue. The degeneration has been traced by some observers into the spinal cord and the sympathetic ganglia.

SYMPTOMS.—1. *Physical.* The physical symptoms of general paralysis of the insane are first apparent in the muscles of articulation and expression. There is an occasional thickness of

utterance, perhaps observable only in the pronunciation of the more complex sounds, and a peculiar convulsive tremor of the upper lip accompanying the least excitement. A similar fibrillar trembling may also be observed in the tongue, when an attempt is made to hold it out. This loss of muscular control gradually spreads over the whole system, its onward course being, however, not infrequently interrupted by very remarkable though generally brief remissions. Before the patient is laid completely prostrate, the affection both of articulation and of gait strongly resembles the failure of coördinate movement produced by drunkenness. In the last stage the patient lies quite helpless; the power of articulation and every kind of voluntary movement are lost; there is also a strong tendency to the formation of bed-sores; and spots of ecchymosis are apt to appear on the application of even gentle pressure. Inequality of the pupils is usual from the commencement of the illness; but they do not often remain long in one condition, sometimes one pupil and sometimes the other being dilated or contracted. A characteristic feature of the disease is the occurrence of congestive or epileptiform attacks, but they are very variable, both in their frequency and in the stage at which they are first observed.

2. *Mental.* These symptoms generally precede the physical, though some cases occur in which the condition of the mind is not such as to attract attention till some time after the motor symptoms have become obvious. Sleeplessness and general restlessness are usually the first indications of the derangement, and with these may be associated transient states of depression and hypochondriacal fancies. Enfeeblement, shown by forgetfulness and incapacity for continuous thought, is generally an early symptom; and in some cases a gradual increase of this enfeeblement, till absolute fatuity is reached, constitutes the prominent mental symptom. A common condition from the commencement is an inordinate disposition to embark in any, even the most impracticable, undertaking that may be suggested. There is always observed a peculiar facility of disposition, generally good-humoured, but liable to be interrupted by fits of passionate excitement. Frequently there is a very remarkable extravagance, both in thought and act. In most cases acute maniacal attacks take place, in which the excitement presents a specially extravagant character. The semblance of probability and coherence found in ordinary acute mania is generally absent. The prevailing ideas are of grandeur, colossal size, infinite number, power, wealth, and rank, all heaped together in wild confusion. Every such maniacal attack marks an appreciable step in the progress of mental decay; and the tendency is always more or less steadily to complete fatuity. In some comparatively rare cases, especially where there is a tendency to phthisis, the mental condition is mainly one of depression. Remarkable remissions of all the symptoms are sometimes met with.

Diagnosis.—The diseases from which general paralysis of the insane requires to be distinguished are paralysis due to cerebral hæmorrhage, embolism, encephalitis, or tumour of the brain; hysterical and tonic paralysis; locomotor ataxy; alcoholic insanity; senile dementia; and muscular atrophy. The diagnosis is generally easy, if attention be paid to the presence or absence of the convulsive tremors in the muscles of articulation at the commencement; the general and progressive course of the loss of coördination; and the peculiar mental facility and extravagance.

Prognosis.—Complete recovery seldom, if ever, takes place in general paralysis of the insane. The ordinary duration of the disease is from a few months to three or four years, though cases of ten years' duration occasionally occur.

Treatment.—In ordinary circumstances the treatment cannot be properly carried out in a private house; removal to an asylum will therefore generally be necessary. Little benefit is to be derived from drugs. The conditions of excitement are held by some to be moderated by small doses of Calabar bean; and turpentine enemata are frequently useful in the epileptiform attacks. The diet ought to be nutritious, but non-stimulating. The food ought to be minced or pulpy, and care should be taken to prevent an accumulation of it in the pharynx, as fatal choking is sometimes produced in that way. If this should be threatened, the tongue should be immediately pulled forward, and the bolus extracted with the finger. On account of the liability to bed-sores, the patient should as long as possible be prevented from lying constantly in bed.

John Sibbald.

GERMS OF DISEASE.—This is a phrase in common use, the acceptation of which is various, and often more or less vague. So far as it refers to actual things or objects, they also are probably diverse in nature, though at present our knowledge of most of them is based rather upon conjecture than actual experience.

As a phrase, 'germs of disease' is most commonly used in the following modes:—

a. A person may be said to inherit the germs of disease when there is reason to believe that the constitutional, general, or local disease from which he is suffering is of a kind which has been common in the family or stock whence he has descended, and when the disease is one which seems prone to manifest itself in this way. It may, in this sense, be said that a person inherits the germs of gout, scrofula, tuberculosis, syphilis, or cancer; and, in either of such cases (with the possible exception of the two latter), no one would, on reflection, be able to find that he meant anything else than that the patient had inherited a certain general disposition, habit, or bodily tendency, in which, under the influence of slight exciting causes, this or that morbid condition should be prone to manifest itself.

b. In a still looser sense, the phrase is sometimes used to signify the mere commencement or initial stage of a certain disease, as when it is said that the germs of a phthisical patient's malady date from a certain catarrhal attack, or that a patient now suffering from a severe brain-affection contracted the germs of his disease in India or elsewhere, on the occasion of some slight sunstroke. Here the expression would be used in a purely metaphorical sense.

c. The phrase is most commonly employed, however, in reference to the real or supposed causes of communicable morbid processes or diseases, either local or general—those which spread either from part to part in the same person, or from person to person in the same community.

In the spread from part to part, as during the 'generalization' of some malignant new-growth, the agency of 'germs of disease' is, perhaps, not unfrequently more imaginary than real. Results are apt to be ascribed to 'infection' where nothing of the kind has been in operation—as when similar perverted tissue-changes may chance to manifest themselves, either simultaneously or consecutively, in different parts of the body, as results of some single or similar underlying cause.

In the spread from person to person of local or general contagious affections, the same possible source of fallacy has to be borne in mind. We must be upon our guard against ascribing too general an influence to 'germs of disease.' In certain cases these may have been in the first place non-existent, as when such a disease has been 'autogenetic,' and in no sense a derivative of antecedent disease of the same kind. This caution is especially applicable in regard to such an affection as erysipelas—which, although certainly contagious, is also on very good grounds judged to be 'generable,' especially during certain states of lowered health induced by renal disease and some other visceral affections. Though not so certainly known, it is by many deemed probable that a similar caution may be necessary in regard to more general contagious affections, such as diphtheria, typhoid and typhus fever, and cholera, which, though certainly contagious, may also be autogenetic. On this subject, however, much doubt and uncertainty still prevail.

The consideration of this third use of the phrase 'germs of disease,' conducts us naturally to the question as to the nature of the things or objects which may be included under the same name, and this again to the modes in which they operate. As these are questions, however, which have already been discussed under CONTAGION, they will only be very briefly referred to here.

The different kinds of contagia, whilst they are all of them to be regarded as products thrown off from the body of a person suffering from a communicable affection, may in essence be either (1) not-living chemical compounds; (2) cast-off and altered tissue-elements; or (3) cast-off micro-organisms of a low type, either in their 'finished' condition or in a germ-stage.

Whilst it cannot positively be said that we have as yet discovered contagia belonging to the first category, our knowledge is a trifle more definite in regard to the existence of those pertaining to the second and third categories. In what proportion these latter kinds of contagia exist, however, for different communicable diseases, still remains to be discovered.

Such different kinds of 'germs of disease' might take effect in two distinct modes, and only in two, since the probable modes of operation of those belonging to the first and second varieties are not at present capable of being discriminated from one another.

First, we have the mode of action of contagia in the spread of local affections, such as ophthalmias, gonorrhœas, and erysipelatous inflammations. Chemical compounds, or diseased tissue-elements, or both in combination, thrown off from such foci of disease, and falling upon suitable situations in other human beings, are capable of determining inflammations of like kind, in which multitudes of new contagia, also of like kinds, are 'independently' produced—that is, are produced otherwise than by processes of organic reproduction. How far such chemical, or 'contact actions' (not necessarily producing inflammations) may take part in, and lie at the root of the very complex group of morbid processes constituting this or that general contagious affection, or so-called 'specific fever,' is not at present known. The processes must be somewhat of this kind, if the operating contagia are not living organisms; and even where they are of this type, it is possible that the same sort of process may obtain.

Secondly, where micro-organisms (bacilli, micrococci, &c.) are the contagia, they are believed to produce their effects by the continuous multiplication, or 'organic reproduction,' of such independent units in the tissues and blood (one or both) of the individual affected. The multiplication of such units, and the chemical changes in the tissues attendant thereupon, are therefore believed to be the sole and efficient causes of the groups of symptoms and tissue-changes constituting the particular general or local communicable disease, and the myriads of contagious elements produced during its progress are regarded as lineal descendants of those which initiated the morbid symptoms.

In the event of its being true, as some hold, that such living organisms as are met with in the blood, and are believed to be at times the causes of certain of the communicable diseases, can arise 'independently' within the body (by 'heterogenesis' or by 'archebiosis'), the second assumed mode of operation of contagia would have to be more or less completely renounced in favour of the first. The contagia, even in this latter case, might simply set up morbid processes, which, instead of being simple (as in those caused by the pus-corpuscle and its fluids from some seat of virulent inflammation) might be complex, prolonged, and linked together, so as to constitute the morbid processes typical of some particular specific fever. At some stage of this complicated chain of processes, and somewhere (that is, either in some organ or tissue, or in the blood), organisms may arise *de novo*, which, either alone or with their parent fluids or tissue-elements, are again capable of acting as contagia. But the organisms in such a case could not be regarded as direct descendants of the original contagia, and similarly no one would think of regarding the pus-corpuscles met with in a case of purulent ophthalmia or gonorrhœa, as direct lineal descendants of those which may have taken part in occasioning one or other of such diseases.

H. CHARLTON BASTIAN.

GIDDINESS (Sax. *gidig*, turning or whirling round).—A synonym for vertigo. *See* VERTIGO.

GINGIVITIS (*gingivæ*, the gums).—Inflammation of the gums. *See* MOUTH, Diseases of.

GLANDERS.—SYNON.: Equinia; Fr. *Morve*; Ger. *Rotz*. Its associated condition is named Farcy; Fr. *Farcin*; Ger. *Wurm*; *Hautwurm*.

DEFINITION.—A contagious febrile disease, communicated to man from the horse, ass, or mule, characterised by specific inflammatory lesions of the nasal and respiratory mucous membranes, and of the lymphatic vessels and glands, with general pyrexia, pains in the joints and muscles, and great prostration, usually accompanied by a pustular cutaneous eruption.

The local manifestations vary in order of appearance, and in comparative severity in different cases. In those in which the nasal and respiratory mucous membranes are earliest or most severely affected, the disease is customarily called Glanders; while to those in which the lymphatic system first and especially suffers, the designation Farcy is applied. But no sufficient reason exists for considering glanders and farcy as distinct diseases. They are commonly associated, and whichever set of symptoms may appear first, the other, as a rule, sooner or later follows. Further, it has been proved that the same virus may give rise to either set of symptoms, or to both. And it would seem that the order of appearance is determined in great measure by the mode of communication of the virus, as well as to some extent perhaps by the condition and constitution of the recipient.

Glanders in man is a very rare disease; and it is only within the last sixty or seventy years that its occurrence has been clearly recognised, and its history made out. When it does occur, it proves fatal in a very large proportion of cases. Taking the acute and chronic cases together, 208 out of 245 are recorded as having terminated fatally. Nevertheless out of 2,026,296 deaths in England and Wales during the four years 1871–1874 only 19 are registered as due to glanders.

ÆTIOLOGY.—There is no evidence to suggest that glanders ever originates in man, whatever may be the case with regard to the lower animals. It is always communicated, and almost always by direct inoculation of virus from a diseased animal. In some few instances the disease has been communicated from man to man. It is scarcely ever met with except among those who are more or less constantly employed among horses, and who are therefore liable from time to time to come in contact with diseased animals, or the morbid discharges from them. The mode of communication can in most cases be easily traced. The rarity of the disease in man, considered in conjunction with its comparative frequency and the rapidity with which it spreads among horses, would seem to indicate that the virus is fixed, and not readily diffusible through the air, and that man is not very susceptible of its influence.

In most cases the history renders it clear that the virus, in semi-liquid or semi-solid form, has been received through some cut or abrasion of the skin or mucous membrane. In some few instances it appears probable that the virus in similar form may have been absorbed through the unbroken mucous membrane or skin. But there is at present no sufficient evidence to show that glanders, any more than syphilis, can be communicated by 'a volatile infecting principle,' although by some it is maintained that such communication may take place. If it were so, the disease would probably spread more frequently and extensively, and become comparatively common.

SYMPTOMS AND COURSE.—However the virus of glanders may have been communicated, a period of incubation, varying from three to eight days, and in some rare instances prolonged even to three weeks or more, ensues before the symptoms of constitutional infection become manifest. The longer the period of incubation the less acute, as a rule, is the course of the disease. The duration of the disease, as well as the order of development of the local affections, varies greatly in different cases. Hence the classification, on the one hand, into cases of *acute*, *subacute*, and *chronic* glanders; and, on the other, into cases of *acute* and *chronic glanders*, and *acute* and *chronic farcy*. But nothing like clear lines of distinction can be drawn between any of these classes.

The earliest constitutional symptoms are a sense of general discomfort, fatigue, prostration, and chilliness, with headache, and obscure pains in the muscles and joints. As the disease advances these pains become more severe, and simulate those of rheumatism. Pyrexia, at first but slight, rapidly becomes established. The pulse is quickened and sometimes full, the skin hot and dry, the tongue foul, the urine scanty and high-coloured; and the patient suffers much from restlessness, sleeplessness, and loss of appetite, often with obstinate constipation. Sometimes the feverishness is intermittent, but more frequently continued, or intermittent at very irregular intervals. Still later rigors occur, more severe than such as may have occurred at an earlier period, followed by profuse sour perspirations and clamminess of skin; the pulse becomes very rapid, weak, and compressible; diarrhœa, with very fœtid stools, succeeds the constipation; the thirst is excessive; respiration becomes more and more difficult and laboured; low delirium, with tremors, is followed by coma; and death ensues from exhaustion. In the acute form, the disease runs its course in an average period of about sixteen days; some cases have terminated fatally within a week; others have been prolonged for four weeks. In the less acute form the duration may be from six weeks to two months. And in the most chronic form, in which all the symptoms are less severe, the duration may extend over several months, and in some cases recovery ultimately takes place.

Local Manifestations. — In association with the constitutional symptoms thus indicated, the following local manifestations present themselves, but, as already stated, somewhat differently in different cases.

The wound or abrasion through which the virus has been introduced, or the spot at which it has been applied (for the wound may have healed), becomes inflamed, tense, painful, and surrounded by spreading erysipelatous redness. The ulcer which appears enlarges, assumes an unhealthy, corroded, chancroid aspect, and discharges dirty sanious and often offensive matters.

The lymphatic vessels of the part become inflamed, and present a knotted, cord-like, and subsequently irregularly nodulated condition—the *farcy-buds* in the human subject. The glands are infiltrated and enlarged, and the whole part is swollen and œdematous. The lymphatic glands and vessels of other parts subsequently become affected, but not perhaps to the same extent as in the horse. Resolution and absorption to a greater or less extent sometimes take place; but much more frequently suppuration of low type, abscess-formation, and the production of foul, ulcerating cavities, with hard irregular edges, and fistulæ follow. At a variable period in the course of the disease, from within forty-eight hours to the end of three or four weeks, an eruption, regarded as characteristic, appears on the skin. This first shows itself as scattered collections of red spots, 'which are very small and resemble fleabites, and soon acquire a papular elevation, subsequently rising above the level of the surface, like small shot, assuming a yellow colour. They lie in a kind of hole in the corium, as if the latter had been punched out' (Virchow). They appear to be due to the deposit of some neoplastic material, which subsequently softens and breaks down. By-and-by they become vesicular (some say from the first they are vesicular), and then rapidly sero-purulent, with inflamed livid bases. When close together these pustules become confluent, and give rise to irregular ulcerated surfaces, with soft, brownish, sloughy coating. Large collections of similar deposit in the subcutaneous tissue give rise to hard, painful, boil-like formations, which breaking down lead to extensive sloughing of the skin and deeper structures, with thick, dirty white, or sanguineous offensive discharge.

The mucous membranes—and first, and especially that of the nose—are sooner or later affected by specific inflammation and ulceration. Whether the inflammatory process begins in them or in the skin is not clearly made out. It probably does so in many instances, but in some cases in man, as commonly in the horse, the disease is probably communicated by application of virus to the mucous membrane of the nose or other part of the respiratory passages, which thus becomes primarily affected.

When the nose is affected (as is always the case in the form of the disease especially called glanders), there is first a discharge of comparatively thin, colourless, 'catarrhal' mucus. This soon becomes thicker and coloured; and there is considerable pain, heat, redness, and œdematous swelling about the nose itself and the adjacent parts of the face. Ultimately the discharge becomes thick, sticky, tenacious, and semi-purulent, of a dirty yellow or brownish colour, and often stained with blood. In all cases probably there is ulceration of the mucous membrane, following tubercle-like deposits in it, and the ulceration sometimes extends so deeply as to lead to perforation of the septum, or partial destruction of the turbinated or palate bones. The ulceration often occurs only in the upper part of the nose, and the mucous membrane of the frontal and other sinuses is liable to be similarly affected. When the lymphatic and cutaneous systems suffer first and especially, the nasal mucous membrane is not affected until towards the termination of the case; and in some instances death has occurred before this affection of the nose has taken place.

Bronchial catarrh with rhonchi heard all over the chest, accompanied by severe cough with profuse expectoration, indicates the implication of other parts of the respiratory mucous membrane. The conjunctiva and the mucous membrane of the mouth, gums, fauces, and especially the tonsils, are often affected to a serious extent; so also is the larynx, hoarseness, pain, and difficulty in speaking resulting therefrom.

Anatomical Characters.—The pathological lesions found on post-mortem examination are such as might be anticipated from the signs and symptoms manifested during life. To these, however, may be added fluidity of the blood; softness and rottenness of the muscles, with hæmorrhagic abscesses in them (considered by Billroth as characteristic); patches of grey hepatization in the lungs, or lobular pneumonia; abscesses in the parotid, submaxillary, and cervical glands, &c.

Diagnosis.—The diagnosis of glanders in man may be difficult in the early stage, particularly if the history be defective, and no external wound appear. But when the disease is fully developed, the signs and symptoms, especially if taken in conjunction with the occupation and history of the sufferer, are sufficiently characteristic. In some rare instances, however, in which the constitutional symptoms have been slight, and the local manifestations have very slowly developed themselves, great difficulty has arisen, and the true nature of the disease has not even been recognised until after death. Rheumatism, typhoid fever, and pyæmia, and, in regard to the more chronic cases, syphilis and tuberculosis, are the diseases with which it is said that glanders may possibly be confounded.

Prognosis.—The prognosis in glanders must be extremely unfavourable. Two or three cases only are on record in which recovery has taken place from the more acute form of the disease. In the more chronic forms, however, the deaths have been only about fifty per cent. The more slowly and less severely the symptoms develop themselves, and the longer the patient survives, the better is the chance of ultimate recovery.

Treatment.—The constitutional treatment should be supporting, stimulating, and soothing, and varied from time to time according to the indications afforded. Quinine in large doses and perchloride of iron may be useful. But at present, although very many drugs have been tried, none has been found having any marked specific effect on the course of the disease. Locally any suspicious wound should be freely cauterized as soon as attention is directed to it. All abscesses and collections of morbid material should, as far as possible, be freely incised, and their contents thoroughly evacuated. The resulting cavities and fistulæ should be frequently and thoroughly washed out with disinfectants, and poultices should be applied. The operator, and those who dress the wounds, should wear indiarubber gloves. Inhalations of iodine or carbolic acid vapour should be frequently practised;

and the nose thoroughly syringed from time to time with disinfectant solutions, as carbolic acid, iodized water, or Condy's solution.

ARTHUR E. DURHAM.

GLANDULAR DISEASES.—A general denomination for diseases of glands of all kinds. *See* BRONCHIAL GLANDS, LYMPHATIC GLANDS, and MESENTERIC GLANDS, Diseases of; also the several special glands.

GLAUCOMA (γλαυκὸς, sea-green).—In its modern acceptation, this word is used to include all the conditions, whether acute or chronic, primary or secondary, which are produced by heightened tension or increased fluid-pressure within the eyeball. The word was originally applied only to those cases of heightened tension in which there is a greenish opaque appearance behind the pupil. *See* EYE AND ITS APPENDAGES, Diseases of.

GLEET.—SYNON.: Fr. *Goutte militaire*; Ger. *Nachtripper*.

DEFINITION.—A urethral discharge, milky, viscid, scant in quantity, appearing as a drop at the meatus urinarius, or as shreds floating in the urine.

ÆTIOLOGY AND SYMPTOMS.—The causes of gleet are:—(1) Chronic inflammation of patches of the mucous membrane of the urethra, remaining after acute gonorrhœa; (2) Chronic congestion (inflammatory or other) of the prostate; (3) Granular patches and warts; and (4) Follicular sinuses.

1. **Chronic inflammation of the urethra.** In the first form, which is by far the most common, the interior of the urethra, naturally pale-pink where unaffected, is dull red, or purplish red, or pale and streaky. These red patches are less elastic than the unaffected parts, and frequently, in course of time, develop into bands of stricture-tissue leading to more or less contraction. The most common positions in order of frequency are, first, the first inch from the meatus; then at 2 to 3 inches; lastly at 4½ to 6 inches, or in the bulbous portion of the urethra. Several months, probably always over six, are needed to develop the patches of inflammation into fibrous bands.

Clap has preceded the present discharge some months, or even a year or two, apparently subsiding altogether for one or two months, and returning again without obvious cause. Pain is either absent; or slight smarting or tickling is felt at the parts chronically inflamed, during micturition or at other times. The precise situation of the inflamed patches is ascertained by passing a bullet-sound or bougie (No. 14 or 16, English) along the passage, or the urethrometer, if the meatus urinarius be too small to admit such a bougie. As the bullet reaches an inflamed spot, slight resistance is noted; and the patient feels pain when it passes over the inflamed or rigid patch. Both resistance and pain cease when the patch is left behind. Should the chronic inflammation have existed long enough to produce fibrous bands, the onward passage of the bullet-sound is checked, or arrested wholly if the bands be too short to permit the bullet to slip past. A smaller bullet or diminution of the urethrameter's bulb allows the obstruction to be passed, and denotes the degree to which the normal expansile capacity of the urethra has been contracted.

2. **Chronic congestion of the prostate.**—Prostatic gleets are caused by (*a*) extension of gonorrhœal inflammation to the prostatic urethra—*chronic prostatitis*; or (*b*) irritation and congestion of a sympathetic kind, excited by masturbation, excessive coitus, stone in the bladder, or piles—the '*irritable*,' or '*relaxed*' *prostate*.

(*a*) In *chronic prostatitis*, with a history of preceding gonorrhœa, there is a scanty discharge, seen only at the meatus when several hours have elapsed since micturition; or there are shreds in the urine. The pain consists of a sensation of heat extending along the whole urethra, often radiating to the buttocks, but felt most *after* micturition. At other times there is dull pain in the perinæum, a sense of weight or fulness of the rectum, rather worse when lying down, and by night than by day. Micturition is performed once or twice, or more times, by night. When micturition is attempted, the urine is often slow to come, and usually a few drops dribble off after the stream ceases. Walking fatigues easily, and brings on the sense of fulness in the rectum. The finger in the rectum generally finds no enlargement, but slight tenderness of the prostate. A bullet-bougie or sound, bent one inch from the point at an angle of 135°, traverses the urethra without causing pain till the bulbo-membranous part is reached. The instrument is there grasped for a few seconds, to pass on again to the neck of the bladder; here, again, pain is felt and resistance made; the latter ceases suddenly as the sound enters the bladder, though the pain still remains. As the instrument is withdrawn, it is expelled rapidly until it is beyond the bulb, where it lies quietly enough, and all pain ceases. The urine withdrawn from the bladder through a catheter is normal, and free from muco-pus.

(*b*) The '*relaxed*,' or '*irritable*,' *prostate* is caused most often by masturbation, or by unsatisfied sexual excitement, which lead to frequent determination of blood to the prostate, without also obtaining that speedy evacuation of the blood which follows the sedative influence of the natural gratification. The gland is turgid, very sensitive, and tender, the crypts and follicles secreting an abnormal quantity of mucus. The swelling of the gland may be sufficient to alter the shape of the urethra; hence micturition may be impeded, and occasionally accompanied by smarting pain. A dull heavy sensation, hardly amounting to pain, is referred to the anus or perinæum; and the pressure of hard fæces during defæcation is often distinctly painful. The passage of a bougie along the urethra causes little pain till the prostate is reached, when the patient may even scream with exaggerated expression of the pain he feels. The instrument is grasped by spasm for a few seconds, when it passes into the bladder, and no more pain is felt. The discharge observed by the patient is transparent, colourless, glutinous, scanty, except when he strains, or is excited by erotic desire, when several drops may come away at a time. In middle-aged men urethral stricture is sometimes

also present, and aggravates the prostatic irritation. The reflex and sympathetic derangements attract more attention than the local condition. An almost invariable accompaniment, if not a consequence, is dyspepsia with its various symptoms; very common, also, are aches and pains in the lower extremities, loins, and other parts. There is often great weariness, especially after sexual intercourse. Intellectually and morally the patient is much affected. Dread of impotence, of loss of memory, of insanity, or even of paralysis, is often a leading symptom.

3. **Warts and granular patches.**—Warts, which are most commonly situated just within the meatus, may stud the whole length of the urethra. Near the meatus they are arboriform, lower down sessile or only slightly pedunculated. Identical in structure with the warts on the glans or furrow of the penis, they are ordinarily papillomata.

4. **Follicular sinuses.**— Follicular sinuses, inflamed during acute gonorrhœa, often secrete discharges long after the gonorrhœa is ended. In the anterior urethra rarely more than one or two crypts are thus chronically inflamed; but in the prostatic portion several crypts secrete a thin translucent fluid, and this form may be looked on as one of chronic prostatitis. In cases of hypospadias, at the extreme end of the exposed urethra, there is in many persons on each side of the orifice a natural crypt three-quarters of an inch long. These often continue to discharge thin muco-pus long after gonorrhœa has subsided. Other sinuses, but shorter ones, open in the situation of the lacuna magna of the normal urethra. None of these follicular sinuses ever form indurated patches in the substance of the urethra; hence they never cause stricture. This may, however, sometimes result from the bursting of an inflamed and suppurating submucous gland, which before its evacuation may have projected on the wall of the urethra, and thus temporarily produced a narrowing. The discharge from such a cavity is much more copious than from a simple follicle, and very slow to dry up, though that usually happens spontaneously if there be no stricture to prevent the easy outflow of the urine.

Treatment. — 1. *Inflammatory patches.* — When the pain experienced from passage of the exploring sound is acute, the resistance small, and the discharge white and thick, the condition is mainly one of congestion; and the injection of three or four minims of a solution of ten to twenty grains of nitrate of silver to the ounce, by means of a Guyon's bullet-catheter and syringe at the places where pain is felt, is then a useful measure. This may be repeated in three or four days, if needed. If there be cling or hitch as the bullet passes along the urethra, the passage of a full-sized (No. 25 or 26, French) metal sound twice weekly is requisite. When no cling exists, the last remains of the discharge may be dried up by using soluble bougies at night (*'Porte remède Reynal'*) for ten to fourteen nights. When congestion has become induration, or even contraction, which does not yield to gradual dilatation, the fibrous band should be divided by a urethratome of suitable shape, until the urethrameter, expanded to the largest size in which it moves freely along the unaffected parts, travels without hitch or cling past the contracted patches.

2. *Chronic prostatitis.*—Usually the cure is slow, and depends much on regimen and diet; with abstinence from alcohol, fatigue, lascivious thoughts, and sexual excitement. To relieve pain and irritation, mild belladonna and opium suppositories may be employed; when the discharge is opaque and tolerably copious, two minims of copaiba in essence of cinnamon and water, or a drachm of solution of sandal-wood oil, with buchu and cubebs, are useful. Locally, when the prostatic tenderness has subsided, cool hip-baths for five minutes night and morning, beginning at 85° F., and gradually lowering the temperature to 50° F., are beneficial. After a week or two the bath may be taken at 50° F., and lowered by ice to 40° F., with advantage. The sitting should not exceed five minutes, but the baths should be continued for several weeks. Counter-irritation is most useful when there is pain and considerable irritation. It should be applied over a large surface by the caustic solution of iodine. It is at best an uncertain remedy.

The *'relaxed' prostate* requires great tact and perseverance for its cure. Regulation of the digestion, prescription of suitable occupation, and encouragement of the patient to throw off his mental despondency, comprise the general treatment. Locally, if the prostate be not extremely sensitive, the passage of the steel sound on alternate days is most beneficial. Dreaded as is the first passage of the sound, the relief that follows is so satisfactory that the patient seldom objects, and generally demands its repetition. When the passage of the instrument is really agonising, the patient should be anæsthetised, his bladder emptied by catheter, and ten to twenty minims of a twenty-grain to the ounce solution of nitrate of silver thrown into the prostato-membranous urethra by Thompson's prostatic injector. This may be followed by a subcutaneous injection of one-third of a grain of morphia before the patient recovers his consciousness. He should keep his bed for one or two days afterwards, and his room three or four days more. Repetition is seldom required, as the sound is then well borne. As a completion of the cure, a long voyage and a year spent in Australian or New Zealand sheep-farming are most useful.

3. *Granular patches.*—These are best treated by passing along the urethra a bougie, which has been dipped for three inches or more into an ounce of melted cacao butter holding suspended in it five to ten grains of peroxide of mercury or nitrate of silver. When cold, this bougie may be inserted into the urethra for ten or fifteen minutes, till the warmth of the body has melted off the cacao butter, by which plan the stimulant is directly applied to the granular patch. Again, twenty drops of a thirty-grain to the ounce solution of nitrate of silver may be thrown on to the granulations by a bulbous syringe. These strong injections should be made only when the patient can rest in his room for twenty-four hours afterwards. The pain is sometimes severe, and needs hot baths, opium, and other anodynes, to allay it.

Warts should be exposed by an aural specu-

lum or endoscope, and touched by a wire armed with lunar caustic.

4. *Follicles.*—The follicles can also be reached through the speculum, and a slender wire armed with caustic run into the mouth of the follicle. Usually, when the discharge is due solely to follicles, it is better let alone. The long sinuses met with at the end of the urethra in hypospadias may be first cauterised; and then, if caustic be not sufficient, slit up with a fine knife and canaliculus-director. BERKELEY HILL.

GLEICHENBERG, in Austria. Muriated alkaline waters. *See* MINERAL WATERS.

GLOBUS HYSTERICUS (*globus*, a ball; *hystericus*, connected with hysteria).—SYNON.: Fr. *globe hystérique*; Ger. *hysterische Kugel.*—A subjective sensation experienced by hysterical patients, as of choking, or of a ball rising in the throat. *See* HYSTERIA.

GLOSSALGIA (γλῶσσα, the tongue, and ἄλγος, pain).—Pain in the tongue. *See* TONGUE, Diseases of.

GLOSSITIS (γλῶσσα, the tongue).—Inflammation of the tongue. *See* TONGUE, Diseases of.

GLOSSO-PHARYNGEAL NERVE, Diseases of.—The glosso-pharyngeal nerve is the special nerve of taste for the back of the tongue and the soft palate, and of common sensation for the same region, and in part for the upper portion of the pharynx, the eustachian tube, and the tympanum. It is also the motor nerve for the stylo-pharyngeus, the middle constrictor of the pharynx, the levator palati, and the azygos uvulæ muscles. It is doubtful whether the fibres for the two latter muscles arise from the roots of the glosso-pharyngeal.

Paralysis.—Very little is known of the precise effects of paralysis limited to the glosso-pharyngeal nerve, since it is very rarely paralysed alone. Sensation in the fauces is certainly lost, and also taste in the back of the tongue and palate, perhaps also to a slight extent in the front of the tongue. The middle constrictor of the pharynx is paralysed, and perhaps also certain movements of the palate and the uvula. From their position, the fibres of origin are commonly damaged in conjunction with fibres of the hypoglossal, spinal accessory, and pneumogastric. The common causes of damage in this situation are meningitis, syphilitic and other growths, and bone-diseases. The nerve may also be paralysed from disease of its nucleus of origin in the medulla oblongata, and then commonly in association with the nerves to the larynx, the tongue, and often the lips (*see* LABIO-GLOSSO-LARYNGEAL PARALYSIS). The sensory part of the nerve may then escape, and only the motor part be paralysed. The causes of paralysis from disease of the nucleus are slow degeneration, softening, hæmorrhage, and probably the effects of diphtheria. In diagnosing paralysis of the levator palati and azygos uvulæ, care must be taken to remember how often the arches of the palate are unequal, and the uvula is oblique, under normal conditions. Defects of movement must be looked for, and especially the unequal dimpling of the base of the uvula in the pronunciation of 'ah!'

Spasm.—Nothing is known of separate spasm in the muscles supplied by the glosso-pharyngeal nerve. In conjunction with the other motor and sensory nerves to the pharynx, it takes part in the production of the spasm of hydrophobia, and in some hysterical phenomena. For over-action in the special sensory function of the nerve, *see* TASTE, Disorders of.

TREATMENT.—The treatment of disorders of the glosso-pharyngeal nerve is never special, but always that of the cause, and is sufficiently described in the several articles which deal with the above-mentioned ætiological conditions.

W. R. GOWERS.

GLOSSO-PHARYNGEAL PARALYSIS.—A synonym for Labio-glosso-laryngeal paralysis. *See* LABIO-GLOSSO-LARYNGEAL PARALYSIS.

GLOSSY SKIN is the name given to a peculiar atrophic condition of the skin, seen principally in the hands, in consequence of irritative lesions of the nerves of the forearm. The skin of the back of the hand, fingers, and even that of the palm is thin, smooth, shining, without furrows, and redder than natural—either uniformly or in patches. The skin seems as if it were stretched over subjacent parts, which are firmer than natural. It may be more or less fissured, or even denuded of epidermis in patches. Secretion of sweat may be increased or altered in quality. The parts may or may not be the seat of neuralgic pains. It was thought by Paget (who described this condition in the *Medical Times and Gazette* for May, 1864) to be a very rare affection, but it was observed by Weir-Mitchell and his colleagues, in the late American war, no less than 19 times in 50 cases of partial division of the nerves of the forearm. It may occur also as a sequence of dislocations of the wrist, where the median nerve is compressed or otherwise damaged.

GLOTTIS, Diseases of. — *See* LARYNX, Diseases of.

GLYCOSURIA (γλυκὺς, sweet, and οὖρον, urine).—A condition of urine in which sugar is present; generally used as a synonym for diabetes. *See* DIABETES.

GOÎTRE.—SYNON.: Bronchocele; Derbyshire Neck; Fr. *Goître*; Ger. *Kropf*; *Struma.*

DEFINITION.—Simple hypertrophy, or cystic, fibroid, or fibro-cystic enlargement of the thyroid gland.

ÆTIOLOGY.—*a. Locality.* Goître is prevalent in magnesian-limestone districts, for example, Derbyshire—hence the name 'Derbyshire neck.' Amongst the continental countries it prevails in are: France, mostly in Savoy; Germany, mostly in the Black Forest; Austria, mostly in Styria; Northern Italy, mostly about the Alps; Switzerland, mostly in the Valais; and Russia, mostly about the Altai mountains in Siberia.

b. Water-supply.—Whenever goître has arisen without being inherited the cause in far the greater number of cases can be traced to some impurity in the potable water. What this impurity is, has not as yet been satisfactorily determined, although it has been proved that the water used in goitrous districts has percolated through a soil which contains an impurity, which is the cause of the malady. Snow-water was in

former days considered to be the cause, but this opinion is met by the statement that goître does not exist in Greenland or Lapland, and that it is prevalent in Sumatra, where there is never any snow. The impurity is stated by many to be due to an excess of lime and magnesia, which theory seems borne out by a geological examination of the localities in which goître is indigenous in England. In the Indian Punjaub, where goître affects 60 per cent. of the population, 59 grains of lime have been found in a gallon of water, '10 grains being an undesirable proportion' (Professor Frankland). The latest authorities on the cause of goître believe the impurity to be of a metallic nature (probably some form of iron), and have shown that metalliferous earths, it may be said almost without exception, are to be found in the neighbourhood of the magnesian limestone districts, where goître prevails. In many limestone localities also bronchocele is entirely absent. Scotland, Ireland, Norway, and Sweden are comparatively exempt from the disease, although mountain limestone is found largely present in their geological formation. Why potable water is the cause of goître has yet to be definitely determined.

c. Other causes.—Epidemics of goître have been notified, as chiefly occurring amongst soldiers in France, probably the result of forced marches through goitrous districts, combined with scarcity of food. In such districts the practice of carrying loads on the head seems largely to increase the ratio of the disease. The notion that goître is indigenous to mountainous districts only is set aside by the fact that in some plains, those of Lombardy for instance, goître is present. Many other theories have been suggested.

Women in this country are much more liable to suffer from bronchocele than men, perhaps on account of their being more frequently water-drinkers, for in India it has been noticed that both sexes suffer alike. During the time of puberty the disease commonly first appears, although it may occur from any time of life up to forty years of age, children having even been born with a thyroid enlargement.

Anatomical Characters.—The whole of the thyroid gland, or both lobes, or one lobe only, may be the seat of the goitrous enlargement. The isthmus is rarely affected by itself. In exceptional cases an accessory lobe is present, and becomes enlarged. The enlargement may be simple soft hypertrophy of the gland, cystic, or fibroid; or cysts may be found interspersed in the substance of a fibroid enlargement. Cysts are formed from the normal follicles of the thyroid, by their distension with colloid material, the epithelial lining degenerating as the cysts increase in size. The cyst-wall is formed by the inter-lobular septa and capsule of the gland. In pure cysts the serous fluid which is secreted from the walls replaces the colloid contents. In the fibroid form the connective stroma increases at the expense of the follicles, and tough bands of nucleated fibrous tissue traverse the organ in all directions, the change generally commencing centrally and extending peripherally. The follicles mostly atrophy, but some may persist in the form of small cysts.

Goîtres in some countries are allowed to reach such dimensions that the inhabitants have to support them in bags. A cystic goître, as a rule, projects externally, but often the fibroid variety does not.

Symptoms and Complications.—The appearance of the swelling, and a sense of fulness in the neck, are often the only symptoms of goître. Added to the sense of fulness, there may be a feeling of dragging or constriction about the throat. More serious symptoms are sometimes present, namely, dysphagia and dyspnœa. The former is rarely present except when the tumour has reached an immense size, or when it presses on the œsophagus, as happens when the lateral lobes meet behind the gullet. Dyspnœa, a more common symptom, may be due to pressure from the goître on the front and sides of the trachea (found more commonly in young people, before the tracheal rings have gained much power of resistance), or on both recurrent laryngeal nerves, causing partial paralysis of the abductors of the vocal cords (crico-arytenoidei-postici muscles); or to a portion of the gland passing behind the trachea, or becoming enlarged beneath the sternum. There is often a temporary enlargement of a goître during the catamenial period and pregnancy; and flooding in childbirth is not uncommon. A tendency to the hæmorrhagic diathesis has been noted. Exophthalmos, with palpitation of the heart, may accompany goître. *See* Exophthalmic Goître.

Cretinism is met with, but rarely, in the goitrous districts of this country. More than half the number of cretins are born of goitrous parents, but a goitrous enlargement need not necessarily be present in a cretin, for instances of cretinism have been reported in which the gland has been entirely absent; still they have the same ætiological connection. When the thyroid gland is absent and cretinism prevails, Dr. Hilton Fagge believes that fatty tumours will be found, almost without exception, in the posterior triangles of the neck.

Diagnosis.—A soft hypertrophy of the thyroid gland can be diagnosed by its general diffusiveness, and the want of consistent hardness.

The presence of a cystic goître can be ascertained by the fluctuation of fluid within its walls. Illumination of the sac for the purpose of diagnosis is of no use. Any doubt can be cleared up by passing a very fine trochar into its centre. Owing to the fact that some cystic goîtres contain a large amount of soft trabecular structure, the fluid withdrawn is likely to be mixed with blood. When the fluid has been entirely withdrawn from a pure cyst, it often happens that blood will be freely discharged from the mucous walls.

A fibroid enlargement of the thyroid gland can be diagnosed by the consistency and hardness of its substance. In some cases, fibroid nodules lie scattered in a general hypertrophy of the gland, and may be of stony hardness. Some difficulty may be experienced in distinguishing between a globular fibroid and a small cystic goître that has thick walls, both of which lie deeply in the neck; but if the exploratory examination be made, as recommended above, the difference can at once be recognised.

The diseases which simulate goître are cancer

of the thyroid gland; calculus imbedded in its substance; lymphadenoma; aneurism; and fatty and other tumours of the neck. A leading point in making a diagnosis is to ascertain, by directing the patient to swallow, whether the swelling is attached to the trachea. In the cases of cancer and lymphadenoma, the history and general condition of the patient will give a leading clue. In connection with cancer, it must be borne in mind that a fibroid enlargement of the gland may become the seat of carcinomatous change. When a fibrous goître closely overlies the carotid artery, a forcible pulsation is conveyed through the tumour, simulating an aneurism.

Prognosis.—The prognosis in goître is very favourable. The occurrence of death from suffocation, due solely to the effects of a goitrous enlargement, is extremely rare. It occurs in those countries where little or no treatment is tried, the tumours being allowed to attain an immense size—their weight sometimes reaching several pounds. The disease is more likely to endanger life when the gland passes behind the trachea and completely embraces it. All the varieties of goître are amenable to treatment, but especially the cystic. Goîtres have been known to disappear without any treatment. This result may be due to the removal of the affected person from endemic influences; or it may happen when the enlargement has arisen during pregnancy.

Treatment.—The general rules requiring attention are removal of the patient from a goitrous district, or complete abstinence from drinking water, unless it has been ascertained to be perfectly pure. General medicinal remedies are only of service when the gland is enlarged by fibroid change, and then iodide of potassium (two to three grains twice a day), with or without iron, may be tried. When the hypertrophy is of the simple soft form, blistering, or painting the surface with the tincture of iodine, or the use of iodine ointment, will be sufficient. If the enlargement is fibroid and of some consistence, then injections of the tincture of iodine into, or setons passed through, the substance of the gland, are most useful. Fluoric acid has been given internally, with or without the injections (*Lancet*, March 19, 1881). The injection of ♏xv to ʒj of tincture of iodine should be used twice a week, then weekly, and afterwards fortnightly. The greater number of cases answer well to this treatment, whilst on others no impression can be made. The time the treatment takes depends on the size of the goître; a month is the minimum required for the cure of a very small goître. The process to be followed when injecting is as follows:—Having frozen the skin over the portion decided upon for injection, by means of the ether spray, and care being taken to avoid transfixing any vein or the trachea, the needle of the syringe is pushed into the substance of the goître, and the fluid injected slowly. The best form of syringe for the purpose is one similar to that used for hypodermic injection, made with a screw-piston. Pain in the course of neighbouring nerves is sometimes felt during the injection, for instance in the ear or at the root of a tooth. When the operation is finished, the needle should be rapidly withdrawn, and the skin where the puncture has been made rolled between the finger and thumb, to prevent any escape of the iodine. If the needle be passed well into the substance of the goître, no fear need be entertained of the formation of an abscess. In favourable cases there will be a gradual enlargement of the tumour, with a slight degree of pain, for some eight or twelve hours; after that time the bronchocele will very slowly decrease in size. As a rule, in two or three weeks' time it will be evident whether the injection is to prove effective. By this form of treatment all scars are avoided. The length of time required for its adoption is often an objection, even when improvement is noted; a case occurred in the writer's experience in which the time needed for the completion of the cure was over a year, the neck being reduced from 17¾ to 13½ inches. Setons made of from two to eight lengths of silk form a very serviceable plan for the treatment of fibrous goîtres. In employing either injections or setons it is not necessary for the patient to discontinue his usual employment.

Biniodide of mercury smeared over the enlargement, the patient being then made to sit with his neck exposed to the rays of the sun for many hours, has proved an effectual remedy in India. A Captain Cunningham, the originator of this plan, treated gratuitously about 60,000 natives in two years. He is said to have never produced salivation, and to have rarely failed in effecting a cure. Ligature of the thyroid arteries has only proved of temporary benefit. Division of the isthmus has been advised when dyspnœa is present. A goître may be removed when it endangers life or keeps the patient from work. The operation is one of comparative safety under the antiseptic system, and when each vessel is divided between ligatures.

The treatment of cystic goître is of one kind, and is always successful. The plan consists in emptying the cyst with a trochar and canula, and then injecting a solution of iron (two drachms of the tincture to an ounce of water) sufficient to expand the cavity again. The patient should be kept in bed on account of the rise of temperature, after a successful injection, with the canula plugged, until the third or fourth day, when a suppurative discharge should have been set up. The metal canula should then be replaced by an india-rubber one (made with a middle layer of webbing), the canula being cut shorter as the cyst becomes smaller, and poultices applied until the goître has disappeared. A cure will be effected in one month to four or five months.

During the injection of the iron-solution into cystic goîtres, it may happen that air passes into a vein which has been wounded by the trochar. As this accident has been followed by instantaneous death, the writer, to prevent this accident, uses conjointly the two following plans, taking care to avoid superficial veins:—1. A tape is passed round the neck under the base of the goître, and held tightly by an assistant standing behind the patient, whilst the injection is going on, and for two or three minutes after. 2. The nozzle is fixed at right angles to the body of the syringe, enabling the injection to be made without holding the syringe below the level of the opening into the cyst, and preventing the injection of air. *See* Thyroid Gland, Diseases of.

Pugin Thornton.

GONAGRA, (γόνυ, the knee, and ἄγρα, a seizure).—An attack of gout in the knee. *See* GOUT.

GONARTHRITIS (γόνυ, the knee, and ἄρθρον, a joint).—Inflammation of the knee-joint. *See* JOINTS, Diseases of.

GONORRHŒA (γονὴ, seed, and ῥέω, I flow).—SYNON.: Clap, Blenorrhagia; Fr. *Chaude-pisse*; Ger. *Tripper*.

DEFINITION.—A contagious purulent inflammation, affecting, in men, the urethral mucous membrane and its continuations; in women, the vaginal mucous membrane and its continuations. Occasionally the conjunctival and rectal mucous membranes, to which the nasal has been added on doubtful evidence, are attacked by gonorrhœa. Certain rheumatoid affections and other complications, to be hereafter mentioned, also attend the disease.

ÆTIOLOGY.—The causes of gonorrhœa are *predisposing* and *exciting*. The chief *predisposing* causes are the lymphatic temperament; great sexual excitement and other fatigue; alcoholic excess; gout; previous attacks, especially an uncured gleet; and lastly, a peculiar proneness to urethritis in certain persons. The *exciting* causes include:—(1) Contagion with (*a*) gonorrhœal pus, or (*b*) acrid discharges not generated by gonorrhœa; (2) excessive irritation of the urethra by prolonged or repeated coitus; (3) masturbation; (4) instrumentation; and (5) the use of injections after coitus.

Gonorrhœa differs so considerably in the two sexes, owing to the diversity of seat of the disorder, that its description may be conveniently divided into two parts.

(A.) **Gonorrhœa in the Male.**—

ANATOMICAL CHARACTERS.—The *seat* of urethritis is at first the mucous membrane of the fossa navicularis, whence it travels onwards, commonly not extending further than to the bulbous or membranous portion of the urethra. The inflammation then dies away gradually, leaving patches of the mucous surface here and there still inflamed. But the inflammation may extend to the submucous tissue, to the glands about the urethra, to the prostate, to the neck of the bladder, and to the epididymis in one direction, or to the bladder or even to the kidneys in another. Renal inflammation nevertheless is most frequently excited by sympathetic irritation, when the neck of the bladder is attacked, and only with excessive rarity by continuous extension along the bladder and ureters. As the inflammation localises itself in the urethra, it penetrates more deeply, reaching the follicles and submucous tissue, and may thus cause thickening and induration of the urethra at these points.

In the acute stage there is general uniform congestion; as inflammation subsides, the general redness becomes patchy, arborescent, and punctiform. The swelling disappears, leaving areas of thickened mucous membrane, fine granulations which develop occasionally into warts, and a plugged condition of the ducts of the submucous and mucous glands, which possibly may cause peri-urethral abscess or subsequent gleet. After a lapse of time the indurated patches may contract, and thereby cause irregularity and stricture of the urethra.

SYMPTOMS.—The length of the interval between contagion and the development of the symptoms in gonorrhœa varies from twelve hours to eight days; but the great majority of claps are evident on the fourth or fifth day after intercourse. Usually early manifestation of inflammation denotes a severe attack. Urethritis from contagion differs in no respect from inflammation otherwise excited, and has no necessary period of incubation.

In the first stage, redness, scanty sticky discharge, and smarting in micturition are the leading symptoms. Febrile disturbance at this early period is most rare. On the other hand, the discharge in many cases precedes all other symptoms. Towards the end of the first week, swelling generally of the penis, especially of the urethra, sets in, accompanied by copious yellowish-green discharge, smarting in the urethra, and aching in the penis, perinæum, and groins. Painful micturition and erections at night are frequent (*see* CHORDEE); and general febrile disturbance is sometimes present. Naturally the disorder subsides in four or six weeks, by gradual cessation of the symptoms; but it is frequently prolonged or brought back to its first intensity by neglect of the precautions necessary against irritation.

The patients' habits often induce variations from the ordinary course, as regards the amount of discharge and the severity of the symptoms. In all cases relapses or re-kindling of the acutely inflammatory stage are common. The acute stage of the disorder terminates in one of three ways:—Cessation of pain and discharge; cessation of pain, with diminution of the still purulent discharge; cessation of all symptoms, except a minute quantity of thin whitish discharge or *gleet*. This scanty discharge is most commonly caused by chronic inflammation at one or two places, continued after the inflammation has ceased elsewhere. Sometimes a stricture, a small wart, or a relaxed prostate secretes shreds of mucus, and thus causes gleet. *See* GLEET.

Thus the course of gonorrhœa has been divided into four stages:—*Preliminary congestion*, lasting three or four days; *acute increasing inflammation*, lasting ten to twenty days; *stationary* stage, of uncertain duration; and, lastly, *subsiding* stage, also of uncertain duration. The discharge varies from its usual form of yellow pus, being in some cases viscid, like mucus, in others serous and very liquid; in rare instances it is rosy or pinkish for some days.

DIAGNOSIS.—The distinction of urethritis caused by contagion from that excited by other causes is impossible when the history of the patient's antecedents is wanting. Certain complications of gonorrhœa are said to follow urethritis only when that is excited by contagion. This proposition is not so clearly established that it may serve to decide the origin of a given case to be contagious or non-contagious. To distinguish urethritis from urethral chancre is easy: urethral chancre is never more than one inch from the meatus, nearly always situate just within the entry, and the ulcerated surface can be seen if the lips of the urethra be separated, or a short aural speculum be introduced. The discharge also from a chancre is not creamy, but

shreddy. The pain in micturition is stinging, but limited to one spot. Syphilis may accompany urethritis, but the disease has its proper initial sore or other characteristic symptoms. Occasionally a slight muco-purulent discharge without pain or much swelling is present during the period of the initial lesion in syphilis. This always subsides spontaneously in one or two weeks. In balanoposthitis (*gonorrhœa externa*) there is no urethral discharge. When the free border of the prepuce is exceedingly small, it may be most difficult to be certain that the discharge does not come from the meatus urinarius as well as from the surfaces of the prepuce and glans. Usually, a thorough syringing under the foreskin will wash away the pus, and permit the meatus urinarius to be watched while the urethra is pressed; if pus oozes forth it is secreted in the urethra. Abscess of the prostate or perinæum may cause urethral discharge, which is distinguished from gonorrhœa by the history and condition of the patient.

Prognosis.—The prognosis of gonorrhœa is favourable if proper precautions be taken early. But in spite of precaution, the disease is sometimes most severe, especially in young lads of lymphatic temperament, or in men of nervous irritable constitution. Gonorrhœa is said also to be liable to run a severe course in persons who suffer from acne. During its continuance any of the complications hereafter mentioned may arise. Further, gonorrhœa has caused death through pyæmia; and more often still it originates anchylosis or destruction of joints, or other painful disablements; while it is the predominating cause of stricture.

Treatment.—The treatment of urethritis may be (1) *abortive*; and (2) *systematic*. *Abortive* treatment is intended to cut short the disease by large doses of specifics, or by caustic injections, before acute inflammation arrives. It is always dangerous, and rarely successful. *Systematic* treatment consists in at first removing all sources of irritation and allaying acute inflammation. Abstinence from alcoholic liquors, sexual excitement, and severe exercise is necessary. Tepid baths and great cleanliness, with support for the penis and testes, are useful. Painful micturition is often relieved by immersing the penis in ice-cold water during the act. A light diet of fish, milk, and vegetables, with salines and laxatives, should be ordered. When the acute stage is passed, the continuance of the congestion is shortened by astringent injections and the administration of copaiba, sandal oil, and cubebs. But these should be withheld while there is smarting, copious greenish discharge, and dull-red congestion of the urethra.

Complications and Sequelæ.—The complications of gonorrhœal urethritis are—(1) Balano-posthitis; (2) Phimosis or paraphimosis; (3) Retention of urine; (4) Lymphangitis and Adenitis (Sympathetic bubo); (5) Hæmorrhage from the urethra; (6) Peri-urethral abscess (*a*) near the glans, (*b*) between the layers of the perinæal fasciæ, (*c*) Cowperitis; (7) Inflammation of the neck of the bladder; (8) Prostatitis; (9) Inflammation of the spermatic cord, epididymitis, and orchitis; (10) Inflammation of the rectal mucous membrane; (11) Conjunctivitis by contact; (12) Sclerotitis and iritis; (13) Rheumatism of the fasciæ, great nerves, or joints; acute synovitis, bursitis, abscess, pyæmia; (14) Stricture; and (15) Warts. Several of these complications are described in special articles, to which the reader is referred; but a few of them require brief notice here.

Stricture, or the development of tough fibrous bands in the submucous tissue in limited areas of the urethra, which prevent the canal from expanding during the flow of urine, is caused by long-lasting congestion and inflammation; the most common seat being the penile portion of the canal, and especially the inch nearest the meatus urinarius, whilst those causing most trouble are commonly at the bulbo-membranous portion. Slowly produced, these contractions seldom attract attention till two or three years have elapsed, and very frequently not until eight or ten years have passed away.

Easily curable, in the early stages, these contractions, by exciting reflex irritation, first of the bladder, subsequently of the kidney, indirectly cause parenchymatous induration and atrophy of the secreting tissue of the latter, and thus seriously affect the nutrition of the body, thereby generating a long chain of morbid changes, which not infrequently end in death.

Retention of urine is produced by gonorrhœa in two ways:—(1) During the acute inflammatory stages by muscular spasm closing the congested mucous membrane at the bulbo-membranous portion. This is of course a temporary evil, though often very painful while it lasts. The bladder should at once be emptied by passing a small (No. 6 or 7 English scale) flexible catheter, and the recurrence of the spasm prevented by saline purges, rest, warm baths, and opiates. (2) In the tightly-narrowed urethra, when stricture has formed, a small amount of local swelling or spasm may block the passage. The immediate treatment consists in passing a catheter fine enough to get through the contraction with the adjuvants just mentioned, and subsequently dilating the contracted parts by one of the various methods employed by surgeons for that purpose.

Hæmorrhage from the urethra is caused by rupture of the blood-vessels of the corpus spongiosum during the violent erections of chordee. Rarely copious or serious, in some cases it has, like hæmorrhage from other trivial causes, been dangerous from its obstinacy. Ice-cold wrappings, notably the india-rubber coil with ice-cold water flowing through it, generally arrest the bleeding speedily. If requisite, a catheter may be passed, and the penis compressed by a bandage tightly wound round the organ.

Inflammation of the neck of the bladder, or, as it is often called, inflammation of the bladder, though real cystitis is rare in gonorrhœa, consists of extension of the mucous inflammation to the neck of the bladder, and is a tedious, often very harassing accompaniment of gonorrhœa. It seldom occurs until the gonorrhœa has lasted two or three weeks, and it may develop at any time during the continuance of that disease. It is denoted by very frequent calls to micturate; great pain during, and especially scalding at the end of micturition, caused by muscular spasm of the deeper peri-urethral muscles; with extrusion

along with the last drops of urine of a small quantity of muco-pus or blood. The usual gonorrhœal discharge ceases almost entirely during the attack, but usually returns when the inflammation of the neck subsides. Never dangerous, this affection derives its importance wholly from the great amount of distress, mental and bodily, which it causes. It is best combated by rest, warm baths, anodynes, and very light diet. It is very prone to relapse.

Prostatitis, that is, inflammation of the substance of the prostate, is a severe complication. It causes swelling of the prostate; painful, slow micturition, and often complete retention; a sense of fulness or weight at the anus; and sometimes great irritation of the bowel, with constant desire to defæcate. Prostatitis may cause abscess, and usually leaves enlargement of the organ. If suppuration takes place, pain increases till matter escapes; then sudden relief follows. The abscess most commonly opens into the urethra, and the pus comes away with the urine; but it may open into the rectum, the perinæum, or the bladder.

The treatment consists mainly in allaying irritation and pain by hot baths, fomentations, and opium; and when retention occurs, the regular passage of a catheter is requisite. When fluctuation is evident, abscesses must be opened in the rectum or perinæum. When the abscess has burst spontaneously, it usually closes in course of time, and the discharge ceases altogether or dwindles to a scanty gleet of no importance. Should the discharge continue copious without abatement after several weeks, or the patient suffer much distress, an incision through the perinæum is proper, through which to drain and close the abscess.

(B.) **Gonorrhœa in the Female—Vaginitis.** This may be acute or chronic. The inflammation begins at the fore part of the vagina, extending to the uterus in one direction, and to the urethra in the other. When attacking the vulva, it causes occasionally abscess of accessory parts, for instance, of Bartholini's gland, or of the lymphatic glands. In the cervix uteri and in the urethra it becomes very obstinate.

Symptoms.—These consist, in the acute stage, of swelling of the genitals, heat, or itching, smarting on making water, and aching pains in the back and loins. The mucous membrane becomes dry and bright red. At first the mucus is thin and transparent, but soon becomes thick, creamy, and copious. The mucous membrane is more or less studded with little eminences (*vaginitis granulosa*). The inflammation becomes chronic in from six to ten or twelve days; the pain, swelling, and congestion diminish or cease; the discharge, less creamy, remains plentiful. It is usually secreted in the cul-de-sac, or in the cervix, or some other part less easily cleared than the anterior part of the vagina. These parts, while inflamed, retain a brighter red colour than the rest of the mucous membrane. Not infrequently, when the inflammation has ceased in the vagina, pus can still be squeezed from the meatus urinarius or some of the crypts opening round that orifice, if the finger be drawn forwards along the under surface of the urethra.

The *duration* is extremely variable; if assiduously treated, so that extension to the cul-de-sac or cervix uteri is prevented, the disease has a duration of about three weeks. But when these parts or the urethra are invaded, the duration is most uncertain, the disease lasting often for months or even years. The length of time that the discharge remains contagious is also most uncertain. Probably any discharge, however scanty and serous it may have become, may cause disease if increased by accidental irritation.

Diagnosis.—This depends on the swelling and red congestion in the acute stage, and on partial excoriation and copious discharge in the chronic stage. The distinction between vaginitis from contagion and vaginitis from non-specific irritation is always difficult, and sometimes impossible, being mainly determined by collateral evidence. It generally has a contagious origin if there be pus in the urethra.

Prognosis.—This is favourable. Sometimes the disorder is cured before it becomes chronic; and dangerous complications are very uncommon.

Treatment.—The treatment of vaginitis in the acute stage consists in allaying irritation by rest in bed, warm baths, frequent injections of warm water, or warm but very weak, astringent solutions, and moderate purgation. The habits and health of the patient must be regulated, and all causes of excitement withdrawn. When congestion has subsided, stronger astringent injections should be efficiently applied, so that the whole mucous surface of the vagina, especially that of the cul-de-sac, is thoroughly laved. Alum or tannin should be applied in powder, by means of the speculum, to the deeper parts of the canal.

Complications.—The complications of gonorrhœal vaginitis are various. Among the earliest is *vulvitis*. The labia and clitoris grow red, swell, and a fœtid discharge is secreted. The patches of epithelium peel from the mucous surfaces, producing excoriation and occasionally ulceration of the mucous follicles. Usually, if the parts are kept clean, the irritation subsides in a few days.

Urethritis is the most constant accompaniment of gonorrhœa. Rarely so acute as to cause much irritation, it may produce severe suffering. It begins with itching and smarting at the meatus, which is red and swollen. A purulent or mucous discharge oozes from the passage, unless the patient have just micturated; even then a little can be found in the mouths of two follicles which open close to the meatus. This discharge is very persistent, and is probably a source of contagion long after the disease is cured elsewhere. The treatment of urethritis consists of frequent baths, astringent injections, and copaiba internally. Obstinate chronic discharges may be arrested by caustic solutions, carefully applied.

Acute inflammation of the cervix and os uteri is a frequent consequence of gonorrhœa. The neck of the uterus is swollen, red, and often excoriated about the os, whence a copious discharge issues, at first clear and viscid, then purulent. This subsides to a thin mucus, and either shortly ceases, or more commonly passes into chronic catarrhal flux, which lasts an indefinite time, and long retains its contagious quality. The acute inflammation is best treated by complete rest, warm baths, warm injections, and saline aperients. In the chronic stage its treatment is that of uterine catarrh.

Metritis, *perimetritis*, and *ovaritis* may also result from gonorrhœa. *See* OVARY, Diseases of; and WOMB, Diseases of. BERKELEY HILL.

GONORRHŒAL RHEUMATISM.—An affection of the joints associated with gonorrhœa. *See* RHEUMATISM, GONORRHŒAL.

GOOSE-SKIN.—A condition of the skin in which this structure is rough and wrinkled, like that of the goose. It is of a transient character, being due to contraction of the muscular fibres of the skin, producing wrinkling of the integuments, and prominence of the hair-follicles; and is observed as the result of the direct application of cold, or of a shock, and in the early stages of fevers.

GOUT (*gutta*, a drop).—SYNON.: Podagra, Chiragra, Gonagra (when the disease affects the foot, hand, or knee respectively); Fr. *Goutte*; Ger. *Gicht*. The name *gout* is supposed to have originated in the idea of the dropping of a morbid fluid into the joints, and is of very ancient date.

DEFINITION.—Gout is a general or constitutional disease, probably depending upon the presence in the system of excess of uric acid, the complaint being, in fact, a manifestation of the *lithic* or *uric acid diathesis*, *lithiasis*, or *lithæmia*. It may be hereditary or acquired; and is characterised ordinarily by a peculiar inflammation of the joints—*articular* or *regular gout*, attended with the deposit of urates in their structures, affecting usually and especially the smaller joints, and at first more particularly the metatarso-phalangeal articulation of the great toe, but afterwards extending to other joints. Similar deposits of urates may occur in other tissues in course of time; and certain organs of the body are liable to become the seat of functional disorders, or of pathological changes, during the progress of the disease—*non-articular* or *irregular gout*; while it is also often attended with general symptoms. Gout in the early part of its course is usually an *acute* affection, occurring in periodic attacks or 'fits'; but subsequently it tends to become more or less *chronic* and permanent, though even then generally presenting exacerbations from time to time. The gouty diathesis may, however, be present without giving rise to any joint-affection or other evident organic mischief.

ÆTIOLOGY AND PATHOLOGY.—The ætiology and pathology of gout are intimately associated, and must be considered in their mutual relations; and there are certain definite points which require to be noticed in this connection.

1. It is necessary to determine the immediate *pathological cause* of the gouty diathesis and its accompanying phenomena. Many views have been advanced, but they all belong to either of two groups, namely, the *humoral* or *anti-humoral*, the former attributing the complaint to some morbid condition of the blood and secretions; the latter to some functional disorder or organic change affecting certain systems of the body, and especially the nervous, vascular, or digestive systems. Loss of nervous tone, a tropho-neurosis, venous and capillary congestion, and plethora of the chylo-poietic viscera, are among the conditions to which gout has thus been attributed. In the writer's opinion an essential element in the development of gout consists in the presence of some special morbific agent in the system; and it is now almost universally admitted that this agent is *uric* or *lithic acid*, which accumulates in the body in abnormal quantity. A variable amount of this substance is being constantly formed in the system during the processes connected with nutrition, but within certain limits, which probably differ in different persons and under different circumstances, it is capable of being eliminated by the kidneys or of being destroyed, and only when the acid accumulates beyond such limits are the gouty phenomena developed. In short, gout may be regarded as a manifestation of the so-called *lithic acid diathesis*, *lithiasis*, or *lithæmia*. The acid exists in the body as urate of soda, and in the gouty diathesis this salt is present not only in the serum of the blood, but also in the fluid that diffuses from it into all the vascular and non-vascular structures of the body (Bence-Jones). There are several arguments in support of this view:—(1) Gout occurs under circumstances which are known to induce in various ways the presence of excess of uric acid in the system; and, further, the causes which are most liable to bring on a gouty paroxysm are those which temporarily increase this excess. (2) While in the blood of healthy persons the quantity of uric acid present is so minute that it cannot be detected by any ordinary tests, in gout this substance may be obtained from blood-serum, even in a crystalline form, either before or during an acute attack in early cases, or at any time in chronic cases. It has also been found in the fluid contained in blebs raised by blisters, provided they are applied at a distance from the seat of any acute gouty inflammation; in inflammatory effusions in serous cavities; and in dropsical fluids, such as ascites. (3) Along with these indications of the presence of excess of lithic acid in the system, during an attack of acute gout the *absolute* quantity discharged in the urine is considerably diminished; while in chronic cases of the disease it is habitually more or less deficient, and at times may be almost entirely absent. (4) Deposits of urates, especially of urate of soda, are formed in the joints and other structures in gout, and this is the only disease in which such formations are found. Every attack of gouty inflammation is attended with the deposit of urates in the affected tissues, but the quantity is not in proportion to its intensity, and therefore cannot be merely the effect of such inflammation.

Assuming this view of the essential nature of the gouty diathesis to be correct, different theories are held to account for the excess of lithic acid in the system, and they are probably all more or less true in different cases, in some instances the accumulation being explicable in more ways than one. Undoubtedly uric acid is often *formed in excess*, so that it cannot be adequately got rid of by elimination or in any other way. This excessive formation occurs in many cases without giving rise to the phenomena of gout, because so long as the kidneys are in good condition, and the nutritive processes are satisfactorily carried on, the acid is eliminated or destroyed. Again, it is supposed that

lithic acid may undergo *imperfect oxidation and destruction* in the body. Both these disorders have been attributed by some writers to a supposed influence of the nervous system. Others attach considerable importance to hepatic derangements in the causation of gout; and here it may be remarked that a distinct connection has been traced in some instances between this complaint and diabetes. Furthermore, the presence of an *undue quantity of other acids* in the blood may in some instances account for lithæmia. If, from various causes, such as deficient action of the skin, excessive consumption of acids or acid-producing food, or the formation of acids in undue quantity during the process of digestion, these acids are present in excess in the blood, from their greater affinity they combine with the alkalies in this fluid, and diminish the alkalinity of the blood-serum, so that it is less able to hold uric acid or urate of soda in solution. *Deficient elimination* is an important cause of lithiasis, and is often associated with other causes. It has been proved experimentally that in birds, if the ureters are tied, uric acid is deposited all through the tissues, but especially in the kidneys. It has been suggested that in some cases of the gouty diathesis the kidneys are congenitally small, and therefore cannot properly excrete even a normal quantity of uric acid, but especially any excess of this substance. Functional disturbances of the kidneys are also liable temporarily to interfere with their eliminating power, being often associated with, and probably due to, excessive formation of urates; while in course of time these organs become the seat of serious organic mischief in gouty cases, which gravely limits their excretory power, and in extreme cases arrests it entirely.

2. We are now in a position to discuss the circumstances under which the gouty diathesis is developed, and the more obvious *causes* with which this condition is associated. There are certain causes which may be regarded as more or less *predisposing*, and these will be subsequently considered; but ætiologically cases of gout may be conveniently arranged into three main groups, according as the disease arises from :—*a. Hereditary transmission. b.* Certain errors in regard to *food* and *drink*; often associated with *deficient exercise. c.* Impregnation of the system with *lead.* In not a few instances, however, it must be remembered that these causes are more or less combined.

a. Hereditary transmission. Gout is one of the most striking examples of a hereditary disease, and once established, it may be transmitted for several generations, even when every endeavour is made to eradicate it; but as the contrary is generally the case, the malady being as a rule more or less intensified by pernicious habits, it becomes in most cases a permanent legacy, handed down from one generation to another. Garrod found that in more than half his cases hereditary taint could be traced distinctly; and the proportion is much greater in the upper classes. It sometimes happens that when gout becomes developed *de novo* in an individual, children born previously are free from the complaint, while those born subsequently are liable to be affected. Hereditary influence may be so powerful that gout arises without any other cause whatever; but most commonly this is aided by indulgence in certain habits to be presently mentioned, perhaps not to an extent which would be considered excessive for people in general, but which is excessive for persons predisposed to gout. This complaint sometimes exemplifies the so-called 'law of atavism,' but this is usually due to the fact that in the generation free from gout every precaution is taken to avoid causes which tend to originate a gouty paroxysm, these precautions being subsequently neglected. The hereditary nature of gout is shown not unfrequently in the age at which the disease reveals itself. Should the predisposition be powerful, the complaint may appear even in children; and the younger the subject who is attacked with gout, the more likely is there to be an hereditary taint. The explanation of the transmission of gout in this manner is a mere matter of theory, and the excess of uric acid in the system has been accounted for in all the ways already mentioned.

b. Errors relating to food, drink, and exercise. In a considerable number of cases gout is originated *de novo*, in consequence of certain errors affecting the diet and habits; or an inherited tendency to the disease is considerably aggravated and promoted in this way. In general terms these errors may be summed up as excessive eating, especially of particular articles of food; undue indulgence in alcoholic drinks; and indolent habits, with deficient exercise. They are frequently associated in the production of gout, and not a few persons who eat and drink to excess, are saved from becoming gouty because they are of active habits, work hard, and take a considerable amount of exercise.

Although all kinds of food may assist more or less in developing the gouty diathesis, those elements which are rich in nitrogen are most injurious, and especially meat. Beef is believed by many to be particularly baneful. The writer has heard vegetarians affirm that meat is the great cause of gout, and that it never occurs when a vegetable diet is adhered to, but for such a statement there is no adequate proof. At the same time it must be acknowledged that this complaint is often in no small degree attributable to the amount of meat which is consumed. Many articles of diet, either from their own nature, or from the manner in which they are cooked, may help in the production of gout, by giving rise to digestive disorders.

The relation of intemperance in the use of alcoholic drinks to the gouty diathesis is highly important, and is abundantly proved by everyday experience. The more potent wines have the greatest influence in causing gout, and port-wine has proverbially been regarded as the most injurious of all. Burgundy, madeira, sherry, and marsala are also undoubtedly capable of developing gout, or of keeping up the disease. The lighter wines are much less injurious, but champagne, and especially sweet champagne, certainly often promotes the gouty condition. Hock, sauterne, moselle, and light claret seem to be least injurious, but even these, if indulged in to excess, may in course of time set up, or, at any rate, intensify the gouty dia-

thesis. Malt-liquors stand next to wines as originators of gout, and undoubtedly those who partake very freely of this class of alcoholic beverages are not uncommonly affected. In this way the disease may be usually accounted for when it occurs among the labouring and poorer classes, but it must be remembered that in these persons an inherited tendency to the complaint may exist. Brewer's draymen especially drink large quantities of ale or porter, and the writer has met with instances in which the habitual daily consumption has been acknowledged as averaging from two to four gallons. Spirits are comparatively feeble in their power of producing gout, as is proved by the rarity of the disease in those countries where this class of drinks are chiefly used, such as Scotland. Rum is said to form an exception to this statement. Cider and perry may unquestionably set up gout, if taken to excess, but they are much more powerful when sweet and not properly fermented. Excessive indulgence in a mixture of alcoholic drinks is probably more deleterious than if one is adhered to. The explanation of the differences in the tendency to develop gout exhibited by the various kinds of beverages is not very clear. They do not depend directly upon the amount of alcohol which they severally contain, but the admixture of certain other ingredients with the alcohol renders it far more potent in producing this effect, and the more alcohol then present, the greater is the likelihood of gout being originated. It is not, however, definitely known what these ingredients really are. At the same time it may be affirmed, as regards wines, that their quality has much to do with their tendency to induce gout. Factitious wines and others of inferior quality, as well as those which are very sweet, or which contain much tannin, are most liable to produce this complaint. Drinks which cause a marked diuretic action are less capable of inducing the gouty state than those which have but little of such an action.

The modes in which the errors as regards food and drink induce lithiasis are probably various. They often directly lead to the formation of excess of nitrogenous products, and especially of uric acid, more than can be eliminated or destroyed in the system. Again, overeating and drinking frequently cause undue production of other acids during digestion, which take the place of uric acid, and prevent its elimination. Moreover, these habits disorder the digestive functions, cause congestion of the chylopoietic viscera, interfere with the hepatic functions, and ultimately set up a permanent dyspeptic condition, all of which assist in the development of the gouty diathesis. It has been supposed that indigestion from any cause might originate this condition, but according to the writer's experience this is certainly not the case. Persons who are hereditarily gouty often suffer from dyspepsia, but the disease may appear in such individuals when digestion has always been carried on without the slightest discomfort. Those who indulge in the habits which originate gout *de novo* are generally dyspeptic, as the result of these very habits. *See* DIET.

With respect to deficient exercise, this undoubtedly promotes the development of gout in many cases. Persons who follow sedentary occupations, or who live indolent and lazy lives, are certainly more liable to the disease; and not a few become gouty because they are able to 'keep a carriage,' and thus are deprived of the exercise which they were previously accustomed to take. This cause probably acts by limiting the conversion of uric acid into other waste products, which can be more easily got rid of; and also by increasing dyspepsia, in consequence of the organs which are concerned in the process of digestion doing their work slowly and imperfectly.

c. Another group of cases of gout which originate *de novo*, are those which occur in connection with *lead-impregnation of the system*. Dr. Garrod found among his hospital patients, that about 30 per cent. of those suffering from gout had been subjected to the influence of lead in their various occupations; and in the writer's experience, not only has the relation between lead-poisoning and gout been frequently exemplified, but some of the worst cases of this disease in its chronic forms occurred in persons who were distinctly under the influence of lead. This metal does not appear, however, to originate the gouty diathesis, unless aided by more or less indulgence in alcoholic drinks, though the amount of the latter consumed is usually far less than would alone account for the condition. It has also been found that gouty persons are remarkably susceptible to the influence of lead; and that when this metal is given to such persons for medicinal purposes, it is very liable to bring on a severe attack of acute gout. Garrod's observations seem to show that lead acts by diminishing the excretion of uric acid by the kidneys; and this authority states that the blood of individuals suffering from lead-paralysis always contains an abnormal amount of uric acid, and that the same probably holds good in all cases of lead-colic.

3. **Predisposing causes.**—It is next requisite to notice briefly the predisposing causes of gout. Beginning with *age*, distinct gouty attacks in a large majority of cases make their first appearance in persons between thirty and thirty-five or forty years old. Those which occur under thirty are, with rare exceptions, more or less hereditary. Well-marked gout is exceedingly rare under twenty, but it may occur even in children, being then, however, invariably strongly hereditary. The complaint usually appears before fifty, and becomes progressively less frequent in its manifestation for the first time after this period of life. It is quite exceptional for gout to commence after sixty-five, but it may begin even in extreme old age. The cases in which the disease is developed during or after middle life mainly originate *de novo*, and one of the reasons assigned for the less frequent appearance of the complaint as age advances is, that then people usually become more careful in their mode of living, and more temperate in their habits. With regard to *sex*, males are far more commonly the subjects of well-marked gout than females. This is mainly accounted for by the difference in the habits of the two sexes. It has also been partly attributed to the occurrence of menstruation in females, which acts to some extent as a safeguard, and in these

subjects gout generally appears after the cessation of this function. When strongly hereditary, gout may appear even in young females, of which the writer has seen some well-marked examples.

Bodily conformation and *temperament* have been credited with a predisposing influence, persons of a sanguine temperament, and of corpulent, full-blooded, plethoric habit of body, being supposed to be most subject to this disease, and to have it in its most acute form. These conditions are often produced by the very habits which originate gout, and certainly persons who are gouty by inheritance often do not present any of these characteristics, while those presenting marked contrasts in appearance and temperament seem to be equally the subjects of the complaint. It is not uncommon in individuals of a nervous temperament, thin and wiry in frame, and they are said to be more subject to the irregular and asthenic forms of the disease. *Social position* and *occupation* materially influence the occurrence of gout. Formerly the complaint was met with almost entirely among the higher classes, and it was looked upon as an aristocratic disease. Now, however, it is common enough among the middle classes, chiefly those who are in affluent circumstances; while there are several occupations in connection with which the disease is very prevalent, such as butlers, coachmen, butchers, publicans and barmen, coal-heavers, porters, hair-cutters, and painters, or others who have to do with lead. It was at one time believed that high mental endowments predisposed to gout; this was obviously a mistake, although excessive mental labour, prolonged worry, and other causes which exhaust and depress the nervous system, do seem to predispose to the disease. As regards *climate*, those climates which are cold or temperate, and especially at the same time damp and changeable, present by far the greatest number of cases of gout, and in most tropical countries this complaint is unknown. This depends partly upon the differences in the nature and amount of the alcoholic drinks employed; partly upon the effect of climate as regards the functions of the skin.

4. Thus far we have been concerned with the pathology and ætiology of the *gouty diathesis*. Now we have to discuss briefly these points in relation to the *local manifestations* of the disease, and especially to the occurrence of *acute attacks*. Although the presence of excess of uric acid in the system is an essential element in the pathology of gout, such excess is often present, and yet none of its more characteristic phenomena are observed. An individual in this condition is, however, at any time liable to an attack of distinct gout, from the action of certain causes which would have no such effect upon other persons. If from any cause the amount of lithic acid in the blood is suddenly or rapidly increased, an acute attack of articular gout may be expected, or some internal manifestation of the disease. This is believed to be directly due to the action of the urate upon the tissues of the joint, which is supported by the fact that even after the first attack a distinct deposit of lithates is found in them, which increases with each subsequent attack. Two views are held as to the explanation of its mode of action. According to one view the urate merely acts as a local irritant, it being supposed that different morbific agents in the system affect different tissues, and that this one acts specially upon the structures which are found in joints, setting up an inflammatory process. The degree of inflammation is, however, by no means in proportion to the amount of lithates which are deposited; indeed, the contrary is usually the case, for as a case of gout becomes more and more chronic, the deposit often becomes very abundant, though the paroxysms progressively diminish in intensity; while it is often found in other structures besides those connected with articulations, without causing any evident inflammation. The second view is that the acute paroxysm is the result of an attempt on the part of the articular structures to eliminate the morbid material, a chemical process of oxidation being set up in the parts where urates are most able or liable to accumulate, by which they are converted into urea, carbonates, &c., and so got rid of. This process gives rise to congestion, followed by inflammation and its attendant phenomena. It has been proved that the inflammatory process does destroy the urate in the blood of the affected parts, and probably the salt which has actually been thrown out is also partly destroyed. No uric acid can be detected in the fluid of a blister placed directly over an articulation which is the seat of acute gout. According to this theory the gouty paroxysm is to some degree salutary, as it helps to get rid of the excess of uric acid in the system.

It is a well-known fact that gout tends specially to attack the smaller joints, and above all the metatarso-phalangeal joint of the great toe, which is the one usually first affected. This is explained in the following way: in gout it is believed that those tissues are chiefly attacked which are either non-vascular, or which are supplied with but few vessels, and through which the fluids pass with difficulty, especially cartilaginous, fibrous, and ligamentous tissues. Such tissues are found in large proportion in the smaller joints. These are also distant from the centre of circulation, and the blood passes through them in a comparatively feeble and languid stream. They are, moreover, much exposed to the influence of cold and wet. And, lastly, with reference to the metatarso-phalangeal joint of the great toe more particularly, this joint is peculiarly liable to injury from pressure, supporting the weight of the body, sudden shocks, &c. Another point observed in the history of gout is, that during an acute paroxysm several joints are often attacked in succession, while the inflammation subsides in those first affected, often with striking suddenness. This is accounted for by the deposit of urates in different joints successively, and when inflammation is thus excited in them, it tends to subside in those previously affected. Not uncommonly corresponding joints on opposite sides of the body are implicated alternately, probably through their nervous connection in the spinal cord. As gout advances in its progress, the articulations become more and more involved with each attack, because those first involved become, as it were, saturated with urates, and

therefore new tissues of the same class are invaded.

An acute paroxysm of gout may come on without any evident *exciting cause* whatever, especially if the disease is strongly hereditary, or has been long established. Under these circumstances outbreaks of the complaint seem to become habitual at certain seasons, or they arise from very slight causes, which need to be less and less obvious as the case progresses. Often, however, some distinct exciting cause can be made out, affecting the digestive organs, the vascular or nervous systems, the functions of the skin or kidneys, or disturbing the system in other ways. The most important are eating or drinking too much, either on some particular occasion, or habitually for a longer or shorter period, until at last a fit of gout terminates the indulgence, it being borne in mind that even apparent moderation may be excessive for a gouty person; indigestible articles of food; neglect of the act of defæcation, or constipation; undue physical work or exertion; exposure to cold or wet, or suppression of perspiration; excessive mental work or worry; emotional causes, sudden, powerful, or depressing, such as sudden joy, a fit of rage, or deep grief; hæmorrhage, acute illness, or other debilitating causes; or injury. The implication of a particular joint may be also due to injury, which may be very slight, such as the pressure of a boot, or the toe being trodden upon. Injury to the knee has caused that articulation to be first affected. As *predisposing causes* of acute gouty attacks, climate and season are highly important. Their characteristics have already been indicated, and undoubtedly gouty paroxysms may often be averted by residence in a warm climate, either permanently or during the colder seasons of the year. Early attacks seem to be most frequent in the spring; then they occur also in the autumn; and subsequently they become more frequent and irregular in their onset. One seizure predisposes to another, and it is a special feature of gout that it tends to recur, this tendency increasing with each succeeding paroxysm, until finally, in many cases, the patient cannot be said to be ever free from the complaint. The occupation of an individual may predispose to the occurrence of gout in particular joints; thus butlers have it in the feet, coachmen and washerwomen in the hands.

It is found in process of time that gouty concretions form in other parts besides in the joints. This is easily explained by the fact that urates tend to deposit in certain other structures which are but slightly vascular, besides those forming part of the articulations. Vascular tissues seem to destroy urates in their passage through them, and thus they are prevented from doing any harm to these tissues. The presence of urates in the blood will account, not only for the chronic gouty state, but also for acute attacks affecting internal organs, or so-called irregular gout. It has been maintained that the development of gout in other structures besides the joints is influenced by the diathesis and habits of the individual, but it is doubtful how far this is borne out by actual experience.

Anatomical Characters.—In its most typical manifestations gout is characterised anatomically by the occurrence of a peculiar form of inflammation affecting certain joints, this being invariably attended with the deposit of urate in connection with their structures. Taking an individual articulation, this is at first the seat of an acute inflammatory process, indicated by the usual signs of increased vascularity and redness, tumefaction, and serous effusion into the interior of the joint, as well as into the surrounding tissues. The results of post-mortem examination show that even in the very earliest period a deposit of urate takes place; and as the attacks become repeated again and again, the signs of inflammation become less and less prominent, while the deposit increases, until at last it may form considerable masses, and infiltrate extensively all the structures entering into the formation of the articulation. The joint then becomes permanently enlarged and distorted, while the ligaments are thickened and more or less stiff or quite rigid, and ultimately complete anchylosis may be produced. The deposit seems to commence in the substance of the cartilage covering the ends of the bones, starting near its superficial or free surface, and gradually extending more deeply, though for a time a thin layer of cartilage lies between it and the cavity of the joint. This deposit at first forms a whitish opacity, but as it becomes more abundant it encrusts the cartilages, and also the inner surface of the ligaments, and the surfaces of fibro-cartilages where these exist. More or less extensive spots or patches become in time distinctly visible, and even the entire surfaces of the bones forming a joint may be covered with a chalky-looking substance. The synovial membrane may also present white points, but the synovial fringes at their margins seem to escape, on account of their vascularity. In the larger articulations the synovial fluid may be thickened, and may even contain separate crystals or tufts of the urate. Subsequently the ligaments and adjoining structures are infiltrated, and it is to this cause that the stiffness or rigidity of gouty joints is mainly due. Distinct masses of deposit may, however, form, and these also interfere with movement. They are known as *tophi* or *chalk-stones*. In course of time the tissues covering a gouty joint may be destroyed, including the skin, the chalky-looking substance being thus exposed, and unhealthy suppuration and ulceration set up.

The opaque white substance characteristic of gouty inflammation is found on microscopic examination to consist of fine crystals, in the form of needles or prisms. They are chiefly arranged in minute clusters, radiating from a centre; and in the cartilages they form a more or less compact network. Chemical examination shows that they are composed of urate of soda.

With reference to the joints which are affected in gout, as has been already indicated, the metatarso-phalangeal articulation of the great toe is the one primarily attacked in a large majority of cases. In rare instances, where an opportunity has been afforded of making a post-mortem examination after only one or two gouty fits have occurred, this joint, on one or both sides, has alone presented any change, even after many years have elapsed since the occurrence of the

attacks. As usually seen, however, the disease has progressively involved many joints. In the feet it may implicate all the articulations, but it is a curious fact that the tarso-metatarsal and the phalangeal joints of the great toe generally escape, or are but little affected. Similarly all the joints of the hands and fingers are often involved. The gouty change not uncommonly extends to the larger joints, more especially those of the legs, but the shoulder and hip-joints are but little liable to be attacked. In exceptional cases other articulations are found involved, such as the temporo-maxillary, those of the spinal column, of the pelvis, or even of the larynx.

Coming now to other structures, deposits of urate may occur in various parts of the body, in connection with bursæ, tendons and aponeuroses, sheaths of muscles, the sclerotic coat of the eye, the cartilages of the external ear, eyelids, nose, or larynx, or under the skin. More or less effusion may be present in bursæ at the same time. In a case which came under the writer's notice, and in which there was not the slightest hereditary taint, in addition to numerous *tophi* in the auricles, there was a mass in the bursa over the right olecranon as large as an egg, a smaller one over the left elbow, several distinct deposits over both patellæ, and others in connection with the tendons of the hands, especially the right.

As regards bone, the periosteum is often affected, and some writers have described a deposit of urate in bone itself; but Garrod has not found evidence of its having originated in this tissue. He considers that the periosteal formations sometimes acquire sufficient size to press on the osseous tissue, and to cause its absorption.

The condition of the kidneys induced by the gouty diathesis is of great importance, and these organs probably begin to be diseased at a very early period in the history of a case of gout, for they may be found distinctly affected when there have been little or no external manifestations of the complaint. In the first instance a deposit of urate of soda takes place, probably within the renal tubuli, which afterwards involves their walls and penetrates to the intertubular tissue. This is seen in the form of white streaks in the course of the tubuli, and of white points at the extremities of the papillæ. The deposit goes on increasing, and a chronic inflammatory process is set up, ending ultimately in the production of the 'granular contracted kidney' (*see* BRIGHT'S DISEASE). Other morbid states in connection with the urinary organs observed in some cases of gout are the presence of calculi, consisting of uric acid, urates, or oxalates; chronic cystitis; or urethritis.

In the course of gout morbid changes of other kinds often arise, affecting different structures and organs, and either occurring as acute events, which may even prove fatal, or being of a chronic nature. These need be only mentioned here, and they mainly include congestion, catarrh, or severe inflammation of some part of the alimentary canal; catarrh of the air-passages, chronic bronchitis, and emphysema of the lungs; fatty disease of the liver; meningitis, neuritis, cerebral hæmorrhage; cardiac changes, including chronic valvulitis and degeneration of the valves, and hypertrophy, followed by degeneration, of the cardiac walls; atheromatous changes in the vessels, hypertrophy of the muscular coat of the small arteries, or arterio-capillary fibrosis; and various diseases of the skin, such as erythema, urticaria, eczema, psoriasis, &c. How far some of these conditions can be attributed to the gouty diathesis, or are merely the result of the same causes which have induced this diathesis, may be fairly disputed. It is worthy of remark that acute inflammation in connection with the heart is not met with in cases of gout, and this has been attributed to the great vascularity of the endocardium and other cardiac tissues, for which consequently the urate has no affinity, or it is destroyed in its passage through them.

The condition of the blood in gout may be here noticed. In early cases the chief deviation from the healthy state presented by this fluid is that during the acute paroxysms the serum contains a distinct excess of uric acid, in the form of urate of soda; and this can be obtained in appreciable quantity, even in a crystalline form. In the intervals the blood is quite normal. When the gouty condition becomes chronic, the excess of uric acid is constant, and oxalic acid can also be frequently detected. In course of time the serum becomes lowered in its specific gravity, its albumen is deficient, and its reaction is less alkaline, in extreme cases becoming almost neutral, owing to the presence of excess of acids. When the kidneys are implicated, urea also tends to accumulate in the blood, and may be obtained in variable quantity. The red corpuscles often diminish in number; and the blood deteriorates in quality as a whole in many cases of chronic gout.

SYMPTOMS.—The clinical history of gout is a very varied one, and the symptoms observed in different cases which are regarded as of a gouty nature are exceedingly numerous and diverse. Whether the phenomena attributed to this disease are always fairly explicable by the presence of excess of uric acid in the system is, to say the least, a matter of considerable doubt. It must ever be borne in mind that the habits which generate gout often give rise to symptoms, and even to definite morbid changes, which cannot justly be looked upon as part of this complaint. Again, the custom which some practitioners adopt, of looking upon every acute illness, particularly inflammation of organs, occurring in gouty subjects, as being due to the lithæmic condition, and of a special nature, and applying the term 'gouty' to every such complaint, is certainly going too far, though it may be acknowledged that gout does often modify their clinical history. It is not easy within a limited space to give even a sketch of the various clinical phases of gout, but before considering the symptoms in detail, it may be well to indicate their general nature. 1. In its typical form gout is in its early stages attended with acute symptoms referable to certain joints, and these tend to recur at intervals, constituting 'fits of gout,' the intervening periods becoming shorter and shorter as the case progresses—*Acute Articular* or *Regular Gout*. 2. These attacks

culminate in obvious chronic changes in the affected joints, with corresponding symptoms—*Chronic Articular Gout*—but even then acute paroxysms are liable to arise from time to time. 3. In connection with the acute attacks, and sometimes preceding them, *general* or *constitutional* symptoms are usually observed; and symptoms belonging to this class become permanent in most cases of chronic gout. 4. When gout affects other organs and structures besides the joints, corresponding symptoms are developed, according to the part implicated. In general terms these may be grouped as cases of so-called *Non-articular*, *Irregular*, *Misplaced*, or *Anomalous Gout*; and when such symptoms are acute in their character, affecting some internal organ, and coming on during the course of an attack of acute articular gout, the joint-symptoms at the same time subsiding, this constitutes what is termed *Retrocedent gout*. It is supposed to be due to exposure to cold or other causes checking the articular inflammation, the elimination of uric acid being thus interrupted, so that it accumulates in the system. The symptoms thus grouped together may, however, be conveniently subdivided as follows:—(*a*) Those indicating more or less functional disorder of certain organs, varying much in intensity, and either being constantly present, or only coming on at intervals. (*b*) Those due to acute inflammatory affections of organs. (*c*) Those resulting from the chronic changes in tissues and organs induced by gout, and from the deposit of urates in different parts. Having given this outline, we may now discuss the symptoms of gout in some detail, but it will be convenient in doing so to adopt a somewhat different arrangement from that just sketched.

1. **Premonitory Symptoms.**—There are certain symptoms, of a somewhat indefinite character, and not of any marked intensity, which are often met with in gouty subjects, or even in persons who have never actually suffered from declared gout, but which distinctly depend upon the lithæmic condition. These may be regarded as premonitory symptoms, for they frequently give warning that the gouty condition is in process of development, and if duly recognized, enable the patient so to regulate his mode of living as to ward off the disease. Indeed, it will be found on careful inquiry that gouty phenomena, which may be very marked, are commonly noticed from time to time before the first actual fit of gout occurs, and there may even be suspicious twinges or uncomfortable sensations about the toes or fingers now and then. In a large number of cases, however, no definite premonitory symptoms immediately precede the first gouty paroxysm; but in connection with subsequent paroxysms, prodromata are usually marked, so that confirmed gouty patients can predict when an attack is imminent. As to the nature of these symptoms, they vary in different persons, and this is supposed to depend upon individual predisposition. The most obvious are digestive and hepatic disorders, attended with marked flatulence and eructations, heartburn, acidity, and constipation or diarrhœa, with unhealthy stools, the tongue being often large, flabby, and much furred; palpitation or uncomfortable sensations about the heart; catarrh of the throat and respiratory passages, violent fits of sneezing, or asthmatic attacks; derangements of the nervous system, indicated by a liability to headaches, giddiness, noises in the ears, disorders of vision, marked irritability of temper and fretfulness or lowness of spirits, languor, impairment of mental vigour and intellectual hebetude, heaviness or drowsiness, sleep, however, being restless, disturbed, attended with unpleasant dreams, and often with grinding of the teeth, numbness or tingling in the limbs, especially in the fingers or toes, neuralgia in various parts, twitchings, startings in the limbs, or muscular cramps, especially in the calves of the legs; profuse perspirations; certain skin-affections; and changes in the urine. This excretion usually tends to become high-coloured, deficient, and to deposit lithates abundantly, or even lithic acid crystals, though at the same time the quantity of this acid eliminated within the twenty-four hours is below the normal. In advanced cases of gout, however, the urine presents very different characters from those just stated, as will be hereafter pointed out, and when habitually depositing urates, it may become pale, watery, and clear immediately before an acute attack supervenes. Some patients are warned of the approach of a gouty fit by feeling unusually well, both physically and mentally.

2. **Acute Articular Gout.**—It is only with the occurrence of the first acute attack of gout that the disease is usually regarded as established. The paroxysm as a rule comes on during the night, while the patient is asleep in bed, and it is said to commence usually between 2 and 5 A.M. The patient is disturbed out of his sleep by uneasiness or pain, generally referred to the ball of the great toe on one side, and the corresponding joint is found to be inflamed, the inflammation increasing in intensity, until it usually becomes extremely severe. In some instances the corresponding joints on both sides are attacked simultaneously, in rapid succession, or alternately. Although, however, in the majority of cases gout first attacks the metatarso-phalangeal articulation of the great toe, it must not be forgotten that it may start in any of the smaller joints of the foot or hand, or even in the middle-sized joints, especially the knee or ankle. Indeed, exceptional cases have come under the writer's notice, which there was every reason to believe were of a gouty nature, and in which the disease implicated several joints at a very early period of its course, the feet, however, being free. In such instances it may be that there is a true combination of rheumatism and gout.

Proceeding now to notice the clinical characters of the joint-affection, severity of the pain is certainly a striking feature in the majority of cases of acute gout, especially in early attacks. When the foot is affected, any attempt to stand causes much pain from the first, and the suffering speedily increases, until it becomes very intense, in some instances almost unbearable. In character it varies, and is described in different cases as burning, throbbing, aching, tearing, plunging, boring, piercing, &c. The pain prevents sleep during the night, but towards morning it tends to diminish, and during the day there is usually comparative ease, an exacerba-

tion again taking place as evening approaches, which goes on increasing towards night. Tenderness is very marked, and is often so exquisite that the patient dreads to be touched, and cannot bear the least movement or jarring of the affected part, or sometimes even the weight of the bedclothes, or the slightest shaking of the room. The objective signs of inflammation in connection with a gouty joint also soon become very prominent as a rule. These are marked redness, which may be very deep and sometimes tends to lividity, while the veins are often enlarged and turgid; considerable local heat, as evidenced to the touch and by the thermometer; and much swelling, the skin covering the part assuming a tense and shining appearance, or even a considerable extent of the limb being œdematous. When several joints in the foot or hand are affected, diffused redness and swelling are noticed. The tumefaction is not only due to effusion into the interior of the articulation, but also into the surrounding tissues, œdema being a marked feature in connection with gouty inflammation. This can be better appreciated when the acute symptoms subside, so that pressure can be borne, which shows the pitting characteristic of œdema, and this may hold on for some time after the other signs have disappeared. However intense the objective signs of inflammation may be, acute gout never ends in suppuration. As they subside, marked desquamation of the skin usually takes place, which is partly due to the intensity of the inflammation, partly to the œdema, the vitality of the epithelium being thus destroyed. As the swelling increases, the subjective sensations generally diminish in severity; but during the progress towards recovery, intense itching is apt to supervene.

An acute attack of gout is almost always attended with more or less *general* symptoms; but it is an important fact that their severity depends upon the extent and intensity of the local manifestations of the disease, and upon the accompanying symptoms. Chills or even actual rigors may be felt at the outset, followed by febrile phenomena, sometimes slight, in other cases considerable, the pyrexia being as a rule strictly secondary or symptomatic. The skin feels hot, and usually perspires, but not profusely; the temperature is moderately raised, presenting no definite variations, though marked remissions are generally observed towards morning; the pulse is increased in frequency; and the digestive organs are much disordered, as evidenced by anorexia, thirst, furred tongue, and constipation. The urine is generally deficient in quantity, and may be very scanty, high-coloured, and concentrated; its acidity is increased; and on standing an abundant deposit of amorphous lithates often forms, varying in colour according to circumstances, being pale-buff, yellowish-red, dark or brick-red, or intense pink if the fever is high. The relative quantity of uric acid in a particular specimen of urine is often increased, but the absolute amount discharged within the twenty-four hours is much diminished. The patient is usually exceedingly restless, and cannot lie with comfort in any position; sleep is much disturbed or altogether prevented; and cramps of the calves of the legs or of other muscles may still further increase his sufferings. All these symptoms tend to increase the constitutional disorder. The temper is generally very irritable, or may even be violent.

The duration of the first fit of gout varies according to circumstances, such as the severity of the attack, the diet and regimen adopted, and probably the kind of treatment which is employed. It usually ranges from four or five days to a week or ten days, but may last two or three weeks or more, there being then commonly intermissions or remissions, and several joints being involved in succession. The termination of the gouty paroxysm may be attended with critical phenomena, such as free perspiration, diarrhœa, or a very abundant discharge of urates. After the attack the patient may not recover his former state of health for some time; but not uncommonly he feels better than before, and as if the system had got rid of some deleterious element. As a rule the affected joints are apparently quite restored after early attacks of gout; but it must be remembered that even after a single fit they are the seat of permanent morbid changes, and these may be distinctly evidenced by more or less deformity or stiffness. Œdema may also remain for a considerable time, especially if the inflammatory condition has been prolonged.

One of the characteristic features of gout is the tendency which it exhibits to recurrence in its acute form. This may not happen if the patient is sufficiently careful, but such an event is of rare occurrence. The rule is for the attacks to be repeated, and to recur with ever-increasing frequency. In not a few instances the second fit does not occur until an interval of two or three years or more has elapsed, but in most this is not prolonged beyond a year. The same interval may be noticed between the next few paroxysms, but as the disease progresses they return twice a year, then more frequently, and at last become more or less constant. At the same time the mischief extends as regards the joints. It may be limited to the great toe for some time, but in successive fits spreads to the other articulations of the foot, to the hands, the ankles and knees, the wrists and elbows, and occasionally even to the hips and shoulders. In short, gout tends in time to involve nearly all the joints indiscriminately, and several may be implicated during a fit. Moreover, those articulations which are repeatedly attacked become more and more disabled and deformed, until a condition of chronic gout is set up. The symptoms in connection with a particular joint tend to diminish in intensity the more often it is affected. As additional articulations become involved, however—and many may be implicated at the same time—the general symptoms often increase in severity, and the patient does not recover in the intervals. The duration of the attacks becomes longer as their frequency increases. The rapidity of the progress of gout is very different in different cases; and the time taken to produce permanent mischief in the joints varies considerably.

It must be borne in mind that variations in the intensity and exact characters of the symptoms of acute gout are observed in some cases.

In feeble persons the subjective and objective symptoms may be comparatively slight, the inflammation assuming an asthenic character, but then the ultimate effects upon the joints are often much worse. Again, the pain in connection with a particular joint depends considerably on its structure, being usually much more marked if its ligaments, or the parts around, are rigid and unyielding. Previous injury or disease affecting a joint may likewise modify the symptoms. Some individuals suffer much more than others, being more susceptible of painful impressions.

3. **Chronic Articular Gout.**—In course of time more and more of the joints become permanently and obviously changed, and prevented from fulfilling their functions properly, so that a condition of chronic articular gout is established, exacerbations still occurring, however—indeed with much greater frequency—but being much less acute in their intensity than in the early stages of the disease, and longer in duration. It need hardly be remarked that there is no distinct line of demarcation between acute and chronic gout. The hands are particularly liable to be much altered by the effects of gouty inflammation. The permanent changes are indicated by the articulations becoming enlarged, deformed, and irregular in shape, often presenting nodulations or bulgings, which may attain a large size, owing to the abundance of the deposited urates. They are also stiff and crippled in their movements, at last becoming quite immovable and rigid, or even completely anchylosed; and being either permanently flexed, extended, or sometimes even bent backwards. The interference with movement and the deformity do not bear any necessary proportion to each other, the one or the other predominating according to the mode in which the deposit of urate of soda has taken place. The more this infiltrates the ligaments and surrounding tendons, the greater becomes the impediment to movement. Gouty concretions in connection with joints feel hard, and by their mere mechanical and irritative effects they are liable to cause damage to the adjoining structures. They may be seen stretching or shining through the skin, and causing it to assume a bloodless appearance, or, on the other hand, rendering it congested and bluish, the veins also being enlarged. Ultimately a gouty abscess may form around the concretions, which opens externally; or the skin may merely give way from the continued pressure. Thus the *chalk-stones* are exposed, and come away either in a liquid form or as solid particles or masses, or occasionally there is a free discharge of pus as well. Ulcers are left, of an unhealthy and atonic character, and usually presenting no disposition to heal. There may be a number of these ulcers in the same individual, on the hands and feet. When bursæ are involved, much deformity is produced. They are easily felt, usually presenting a combination of hardness and fluctuation, due to the presence of concretions and of fluid in the bursal cavity. These signs are chiefly noticed in the bursa over the olecranon. Abscesses may also form in connection with these deposits, and the latter may thus be completely got rid of, the abscess subsequently healing rapidly.

In cases of chronic articular gout the general system necessarily tends to become affected. The patients are generally more or less feeble and wanting in tone; they may be thin and pale or sallow-looking; or plethoric, but with flabby tissues, and presenting signs of languid circulation, with enlarged capillaries about the face. They often suffer from disorders of digestion and other symptoms already described; but not uncommonly, as gout assumes a more chronic form, patients feel better, becoming habituated to the morbid condition of the blood. It is remarkable that those suffering from numerous gouty abscesses often exhibit but little general disturbance, probably because the system is thus rid of the morbid materials. The urine in chronic gout generally becomes abundant, very watery and pale, of low specific gravity, deficient in solid ingredients, especially in uric acid, which at times may be almost completely wanting, or it may be thrown out in an intermittent manner. Deposits of urates are not often observed in cases of advanced chronic gout, except perhaps before the occurrence of an acute exacerbation.

4. **Irregular Gout.**—The clinical phenomena which are recognised as irregular manifestations of gout may assume either an acute or chronic form. They may be observed in persons who are distinctly subject to articular gout; or in those in whom the disease is not so obviously revealed. Moreover, their intensity is often in an inverse ratio to that of the joint-affection, and the two classes of symptoms may exhibit a remarkable tendency to alternation, when the articular symptoms are prominent those connected with other parts being slight or absent, and *vice versâ*. This may be noticed with both acute and chronic symptoms, and the former are particularly liable to arise when, from any cause, during the progress of a gouty fit the joint-inflammation is suppressed suddenly or rapidly—*retrocedent gout*. At other times the internal symptoms seem to be due to a want of development of the external phenomena—*suppressed gout*, and when the latter appear, the former subside.

It must suffice to indicate here the general nature of the symptoms of irregular gout. The acute symptoms are mainly associated either with the alimentary canal, the vascular system, the respiratory organs, or the nervous system. In connection with the alimentary canal, acute dysphagia may occur, attended with spasm of the pharynx and œsophagus. The most important symptoms belonging to this group are, however, those due to some gastric disturbance. This may be of the nature of severe cramp or gastralgia, characterised by a sudden, acute, spasmodic pain in the epigastrium, relieved by pressure, and accompanied with a sense of great weight and oppression; the patient presenting an aspect of much suffering, distress, and anxiety; or being even more or less collapsed and prostrated. In other cases the symptoms are those of acute gastritis, bilious vomiting being prominent. Intestinal colic, or even muco-enteritis, may also occur in connection with gout. The vascular system is not uncommonly implicated. The

heart is liable to be disturbed in its action during the attacks of gastralgia, but this disturbance may also be observed independently. It is usually of nervous origin, and may be evidenced in various ways. Thus there may be severe palpitation, the action of the heart being very rapid, irregular, or even intermittent, this being accompanied with most unpleasant sensations over the cardiac region, præcordial anxiety, often a feeling of oppression or constriction, dyspnœa or a sense of suffocation, and much distress, anxiety, and dread of death; the pulse tends to be weak and small, or may be irregular; sometimes the attacks are attended with signs of collapse. In other instances the cardiac disorder is evidenced by very feeble or slow action, with a tendency to syncope. Again, there may be all the phenomena of a severe anginal attack, this probably partly depending upon the circulation in the vessels being impeded. It must be once more noted here that there is no true gouty acute inflammation connected with the heart, although certain chronic changes sometimes observed at *post-mortem* examinations have been attributed to such a condition. Irregular gout affecting the respiratory system is mainly indicated by asthmatic attacks. In some cases there is a marked liability to acute catarrh of the air-passages. Pulmonary congestion is also supposed to be a manifestation of retrocedent gout in some cases, but there is no such special disease as gouty pneumonia. In connection with the nervous system gout may give rise to attacks of severe headache; delirium or even acute mania; epileptiform fits; cerebral or spinal meningitis; acute neuralgia, either external or internal, and especially sciatica, probably due to neuritis; or severe muscular cramps. Apoplexy from cerebral hæmorrhage has been often attributed to suppressed or retrocedent gout, and if the vessels of the brain are diseased, it is possible that there may be some connection between them. Cerebral congestion might also occur in gout, and give rise to a temporary apoplectic attack. Among the acute forms of irregular gout are, for example, skin-affections, eczema, erythema, or urticaria; affections of mucous membranes, such as the conjunctivæ and lachrymal passages; functional renal disorder, with albuminuria, or irritability of the bladder; and local signs of inflammation, associated with the deposit of urates.

Many of the more chronic symptoms associated with gout have already been pointed out, when speaking of its premonitory symptoms, and only certain phenomena need be alluded to here. Chronic skin-diseases are of frequent occurrence, namely, psoriasis, chronic eczema, prurigo, either local or general, and acne. These may alternate very distinctly with articular gout, and they are often intensified by causes which increase the lithæmic condition. In some gouty subjects daily paroxysms of heat and redness of the nose, attended with severe itching and irritation, cause considerable annoyance or distress. Many of these individuals are also liable to chronic catarrh, affecting the throat and the air-passages; and in time they often become permanently asthmatic, the lungs being emphysematous, and dry bronchial catarrh being established. Gravel or urinary calculus gives rise to symptoms referred to the urinary organs; and those indicative of chronic urethritis or cystitis may be present, especially in persons advanced in years. Permanent disorders of sensation, or slight local paralysis may be observed in gout, owing to chronic changes involving particular nerves. Gouty persons are usually very sensitive to pain. Tophi can be seen or felt, provided they are superficial. Those connected with the helix of the external ear are most common; but they should also be looked for in the sclerotic or eyelids, in the nose, and under the skin, in the region of tendinous aponeuroses, especially in the leg or thigh. The writer had the opportunity of observing a case in which an extensive formation of urates occurred in the outer part of the thigh, apparently associated with the fascia lata. These gouty concretions are originally liquid, and if one is punctured at an early period, an opalescent or milky fluid escapes, which on microscopic examination is found to contain an abundance of delicate, acicular crystals; subsequently they become more consistent, and ultimately quite solid and hard, being then made up entirely of these crystals, which are closely aggregated together and interlaced. Taking the ear as an illustration, at first a small elevation appears under the skin of the helix, like a vesicle, having a soft feel. This gradually hardens, until finally a little bead-like or pearl-like body is formed, presenting a whitish colour as seen through the skin. In course of time the cutaneous covering may be destroyed, leaving the little chalk-stone exposed; or this may even become detached, so that only a small depression is left.

5. **Symptoms due to chronic organic diseases.**—In addition to what has been stated under the preceding heading, it is desirable just to notice separately certain diseases of organs which may be associated with the gouty diathesis. Disease of the kidney is indicated mainly by the changes in the urine, which may be slightly albuminous, or even contain a few casts. Other symptoms of chronic Bright's disease may be present, but it must be remembered that in the form of renal disease associated with gout the symptoms are often very obscure. The chronic cardiac diseases observed in gout are revealed mainly by their respective physical signs; and there may be symptoms, first of excessive cardiac action from hypertrophy, and subsequently of cardiac failure. The vascular changes are evidenced by examination of the arteries; and by their effects upon the circulation. Fatty liver can only be discovered by physical examination.

Diagnosis.—The degree of difficulty experienced in arriving at a diagnosis with respect to gout, is very variable in different cases, whether in definitely fixing upon this disease, or in distinguishing it from other affections. Often the diagnosis is perfectly clear, but in some instances it may be extremely difficult to form a positive opinion. It must be remembered that there may be a distinct gouty diathesis present, and symptoms resulting therefrom may arise, which it is important to recognise, while the joints are quite free from any apparent mis-

chief. It is also desirable to be able to make out any tendency to the development of this diathesis. In most cases, however, the diagnosis has to deal with the nature of an articular affection, and to determine whether this is gouty or not. The chief diseases from which gout has thus to be distinguished are acute or chronic rheumatism, and rheumatoid arthritis. The data upon which a conclusion has usually to be formed with regard to a first attack, are the presence or absence of a hereditary tendency to gout, as well as its intensity; the age and sex of the patient; his social position, occupation, and previous habits; the presence or absence of any obvious cause for the attack, or of premonitory symptoms; the localisation and characters of the joint-affection; the general symptoms; the characters of the urine; the duration of the illness; and the condition of the heart. These different points have already been sufficiently discussed in their relation to gout, but the distinctions presented by acute rheumatism may be briefly indicated. The absence of any hereditary tendency to gout in any doubtful case may be in favour of rheumatism, and possibly this complaint may be hereditary. It occurs most frequently for the first time in early life, from sixteen to twenty years of age, and is not uncommon even in young children. Rheumatism, though more common among males, often attacks females. This complaint is not favoured by the habits which generate or promote gout, and affects all classes of persons, but especially those who from their occupation are liable to be exposed to cold and wet. Such exposure, or some other definite cause originating 'a cold,' usually accounts for an attack of acute rheumatism, and it is not preceded by any particular premonitory symptoms. The joints involved are the middle-sized or the larger ones, several of which are generally implicated in succession during the illness, the rheumatic inflammation exhibiting an erratic character; the local symptoms tend to be less severe than in gout; there is less marked œdema about the joints, and no enlargement of the veins or subsequent desquamation are observed. It must not be overlooked, however, that gout may attack the middle-sized joints. Pyrexia is high as a rule, and is often quite out of proportion to the extent of the articular affection; while profuse acid perspiration is almost always a prominent phenomenon. The urine is simply febrile. The attack lasts a considerable time, perhaps several weeks, if it is at all severe; while during its course some acute cardiac inflammation is liable to supervene, and this may happen even when the joint-affection is but slight. The subsequent progress of gout is important in diagnosis, for its tendency to periodic recurrence is a marked feature in its history, and if the metatarso-phalangeal joint of the great toe is alone inflamed several times in succession, or even if only the smaller joints of the feet and hands are implicated, the diagnosis of gout is tolerably certain. The permanent articular changes induced by gout also become evident in time; as well as, perhaps, tophi in other parts, which should be carefully searched for in any doubtful case, especially in connection with the external ear, the nose, and bursæ. Moreover, the urine presents peculiar changes as the disease progresses, and may give evidence of renal mischief. In very doubtful cases it might be desirable to raise a blister, or even to take a little blood from the patient, and endeavour to obtain crystals of uric acid from the serum.

Rheumatoid arthritis is usually met with in females between twenty and forty years old. There is no hereditary taint, or a history of any such habits as generate gout, but, on the contrary, the patients are generally poor, hard-worked, and badly-fed, and consequently weak and wanting in tone; all joints seem to be equally liable to be affected, both large and small, and the symptoms are not of a very acute character, though the pain may be very severe, but they tend to continue for a long period; the general symptoms are mainly those of debility and anæmia. Rheumatoid arthritis is a disease which tends to progress, involving joint after joint, but it presents no periodicity in its attacks, and often advances without any intermission, as a subacute or chronic disease. Ultimately it often causes much deformity and crippling of the articulations, but this results from a very different pathological change from that which takes place in gout, for there is not the slightest deposit of urates, either in the joints or elsewhere; nor in the most extreme cases can any uric acid be obtained from the serum. The urine presents no special characters; and the kidneys are not diseased.

As exceptional points bearing upon the diagnosis of gout in joints, the following may be mentioned. It has happened that pyæmia beginning in the great toe has been mistaken for gout, but the progress of the case would soon clear up any doubt under such circumstances. Again, articular inflammation from injury might resemble gout; and, moreover, it must be borne in mind that such an injury may really set up gouty inflammation for the first time, so that the joint may not recover properly. In some individuals the ends of the phalanges of the fingers are enlarged, especially terminal ones, and cause nodulations—*digitorum nodi*—which resemble those of gout, and are by some regarded as being of a gouty nature.

The importance of recognising the signs of the gouty diathesis, apart from the joint-affection, has already been alluded to. Equally important is it to be prepared for the acute symptoms in connection with internal organs which occur in this diathesis, whether along with or independent of articular disease. Lastly, in any gouty case the detection of the organic diseases liable to be set up in its course is of great moment in diagnosis, especially renal disease; and also the association with their proper cause of catarrhal affections, skin-diseases, and other complaints, when these are due to gout.

Prognosis.—The first point relating to the prognosis of gout which calls for notice refers to the immediate dangers in any particular case. A simple acute attack of articular gout rarely, if ever, kills the patient. When, however, internal organs are implicated, the matter becomes much more serious, and a fatal result may occur, so that the prognosis must be a guarded one under such circumstances. The danger then becomes much greater if the complaint has been

long-established, and if the kidneys or other organs have become structurally diseased. Indeed these diseases of organs themselves are attended with grave dangers, and may give rise to fatal consequences at any time. Again, any acute inflammation occurring in a confirmed gouty subject is the more serious on this account; and the same remark applies to injuries and shocks of all kinds, so that in such cases the prognosis is less favourable than it otherwise would be.

In the next place the future of a gouty patient has to be considered, as regards the prevention of subsequent attacks, or, indeed, the cure and eradication of the disease. It must always be recognised that gout is a recurrent affection, and complete immunity can never be guaranteed, once the complaint has declared itself. At the same time undoubtedly not a few cases have occurred in which there has been but one attack, but this can only be expected under certain conditions. In giving an opinion on this point, the prognosis in any individual case will depend upon:—1. The degree of hereditary tendency to gout. 2. The age of the patient; for the earlier the period at which the disease begins, the less hopeful is the prospect of a cure. 3. The time the complaint has lasted from its commencement; and the frequency and duration of the gouty fits. If gout has become established, and especially if distinct chalk-stones have formed, it is quite impossible to eradicate it. 4. The habits, mode of living, and occupation of the patient. It is only when the patient is prepared to adhere strictly to proper rules of living that a cure can be hoped for. Those who in their occupation are liable to drink much, or who are exposed to cold or wet, are less likely to be cured. It may be remarked here that gouty subjects are less able than others to resist exposure.

Another point bearing upon prognosis refers to the duration of life in gouty persons. If the disease comes on late in life, and the paroxysms only occur at long intervals, while the organs are free from any organic mischief, gout may not appreciably shorten life, and the patients may even enjoy good health up to an extreme old age, provided they are sufficiently careful in their mode of living, and no accidental complications arise. Chronic gout unquestionably does tend to shorten the duration of life, to a greater or less degree in proportion to its severity, and more especially to the indications present that the kidneys, heart, or other important organs are organically diseased. This tendency is now recognised by most life-insurance companies.

It has been supposed that gout is a protection against certain other diseases, such as phthisis and diabetes, and therefore its presence has been in some instances regarded as a benefit, but how far there is any real foundation for this belief is a matter of considerable doubt.

Treatment.—It is important at the outset to lay stress upon the fact that, although there are certain well-defined principles applicable to the treatment of gout in its various phases, it is a great mistake to follow a regular routine method under all circumstances, and every case must be considered on its own merits, both as regards the patient himself and his surroundings. It will be convenient to discuss this subject under certain general headings, premising that the administration of medicines is often the least important part of the treatment, and that the habits of life of the patient always need thorough supervision in all their details.

1. **Preventive and Curative Treatment.**—In a number of cases the primary object which should be aimed at is to prevent the development of gout; or to eradicate the tendency to subsequent attacks, if it has once declared itself, and to rid the system of the conditions which induce this complaint. These objects have especially to be kept in view in dealing with individuals who have a marked hereditary predisposition to gout; in cases where it has appeared at a comparatively early period of life, whether as a hereditary or acquired complaint, or where it is in an early stage; and in persons who, from their occupation, known habits, or the symptoms they present, are likely to become gouty. Moreover, even when confirmed gout has been established, preventive treatment may be carried out, with the view of diminishing the number of acute attacks, or even possibly of averting them altogether; and of obviating the implication of organs essential to the well-being of the economy. In order to carry out these objects in any particular case, the patient must intelligently recognise the fact that success in treatment mainly depends upon himself, and upon his willingness constantly to regulate his mode of living according to principles suitable to his condition, which need to be more or less strict in different instances. The general nature of the rules to be adopted will be evident from a consideration of what has been stated in discussing the ætiology and pathology of gout, but they require to be briefly noticed here. The ends sought in carrying out these rules are to prevent an undue formation of urates in the system; to maintain the digestive and assimilative organs in a condition of healthy activity; and to promote the elimination of urates by the kidneys, especially if at any time there appears to be a tendency to their accumulation in the body.

(*a*) *Diet.*—Moderation in the quantity of food is the first point to be attended to in the treatment of the gouty diathesis. It is not necessary or desirable to restrict persons who are gouty to a very low diet, as is sometimes done, especially if they are in any way weak, but an amount sufficient for proper nourishment in each individual case must be consumed, and at no meal should the stomach be uncomfortably filled. The meals must be taken at regular times, and not hurriedly, so as to avoid bolting of the food. Very late dinners, as well as suppers, should be prohibited, but it suits many persons better to dine at six or half-past six o'clock than at midday. The nature of the food is highly important. It is quite unnecessary, and probably would be in most instances injurious, to restrict the patient to a vegetable diet, but a due proportion of animal and vegetable substances should be allowed. At the same time, in persons who have any tendency to gout, an essential part of the treatment often consists in diminishing the amount of meat which they consume, this being far in excess of what is needed, or can be got

rid of by the system without injuring it. Indeed, the aim must be to reduce all kinds of nitrogenized food, whether animal or vegetable, to such an amount as the system can satisfactorily dispose of, due regard being had to the proper nutrition and strength of the body, and thus to diminish the waste-products resulting therefrom. As regards the kinds of animal food which are suitable for gouty subjects, white fish, chicken or fowl, game, and mutton are the best forms. Tender and underdone beef may be taken in moderation from time to time. Pork or veal, dried and salted meats, and rich dishes of all kinds, had better be avoided. Such vegetables should be partaken of as are known to be digestible, but those which contain much woody fibre, or which create flatulence, must not be indulged in. There is a notion that celery is beneficial in gouty cases, and the writer has recently met with an intelligent person, who has long been a martyr to gout, and he strenuously affirms that he has derived much benefit from taking celery freely, both in an uncooked form and stewed. Gouty subjects should either abstain altogether from, or only take a very limited quantity of, sugar and saccharine articles of diet. Hence, although digestible fruits may often be taken with advantage in moderation, those which are very sweet must be used with particular caution. Stewed and baked fruits often agree well, but fruit-tarts, and, indeed, pastry of all kinds, should be interdicted. The juice of oranges or lemons is considered beneficial for gouty persons, and perhaps with good reason. It may be laid down as a rule to be invariably followed, that such persons should always limit themselves to simple meals, and not indulge in a number of courses; and that they should avoid everything which their experience tells them is, in their case, indigestible. It has been recommended that salt should be avoided by gouty subjects, so as not to add sodium to the system, for combination with uric acid.

(*b*) *Drink.*—The question of drink demands the most careful consideration and attention in every case in which gout is either threatened or has become established. It may be affirmed that no strict rules can be laid down, applicable to all cases, but there are certain broad principles which have to be borne in mind. An abundance of good and pure drinking-water is to be commended, but it should be taken mainly between meals. It is a good plan for the subjects of lithiasis to take a tumblerful of water before retiring to rest at night. Effervescing potass- or lithia-water may be substituted for ordinary water with advantage, the dissolved salts forming soluble compounds with uric acid, but soda-water must be avoided. Tea and coffee may be taken in moderation, provided they do not disagree. With reference to alcoholic drinks, in a considerable number of instances one of the first objects in the treatment of the gouty diathesis should be the regulation of the use of this class of beverages. This indication is obvious enough when the condition is evidently due mainly to excessive indulgence in these beverages; but even when the patient is temperate, it may be that in his case the amount consumed needs to be reduced or total abstinence enforced, especially if there should be a strong hereditary predisposition to gout, or if the complaint appears in early life. Some patients are undoubtedly better if they take no stimulants whatever; others, however, can take proper kinds in moderation with advantage. It may be laid down as a general rule that malt liquors and all stronger wines are injurious, and should be interdicted. Those which are most suitable are good claret, hock, moselle, chablis, or sauterne. Even these must, however, be only indulged-in in strict moderation. A small quantity of good dry sherry suits some gouty patients very well. A little brandy, well-diluted, often agrees better than any other kind of alcoholic liquor; or in some cases whisky or gin may be substituted. Whatever stimulant is selected, it should only be taken at meal-times, and the habit of drinking between meals is strongly to be deprecated. Persons who are distinctly gouty should avoid any excess on every occasion; and even if they do not absolutely abstain, they may find it beneficial to do so from time to time, especially if there should be an abundant deposit of lithates in the urine, or if symptoms should occur which the patient recognises as being of a gouty nature. It is highly important that any alcoholic drink employed by gouty subjects should be sound and of good quality, There can be no doubt but that due attendance to the rules just sketched will prevent the development of gout where it is threatened, and will also check its progress, and avert the occurrence of acute attacks. The difficulty is to persuade patients to carry them out properly.

(*c*) *General hygiene.*—Inadequate exercise is a hygienic error which has frequently to be rectified in the treatment of the gouty state. Sedentary habits must be combated, whether due to the occupation or to indolence; and it must be insisted upon that a due amount of out-door exercise is taken daily, though violent exertion, tending to cause fatigue and exhaustion, must be avoided. Walking and horse-exercise are highly beneficial, especially in the case of those who live rather too freely. Even carriage-exercise is useful, so that the patient may have the benefit of the fresh air. General active habits should be encouraged, and any disposition to undue luxuriousness in the mode of living checked. The patient should retire to rest and get up early. Another point of importance, more particularly with reference to the vocation of the patient, whether professional or other, is that he should as much as possible avoid excessive mental labour, or any great strain upon the mental faculties, but especially worry and anxiety of all kinds. The writer has at present under observation a case in which the influence of these causes in bringing out eczema and other irregular symptoms of gout is strikingly illustrated. It is also important to pay attention to the cutaneous functions, and to protect the surface of the body from the injurious effects of cold. Warm clothing should be worn, in keeping with the weather, and those who can bear it may wear flannel next the skin. With regard to baths, many persons are decidedly the better for using a cold or tepid bath every morning, followed

by energetic friction; in other cases the employment of the warm bath at proper intervals, or even of the Turkish bath, answers best. It is certainly beneficial in some instances, either for those who are already afflicted, or those who are threatened with gout, to go through a course of treatment in a hydropathic establishment from time to time, under due medical supervision. Climate demands attention, whenever the circumstances of the patient allow a choice to be made. It may be advisable for gouty patients to reside permanently in some warm and equable climate, or at any rate during the winter and early spring. In this way attacks may often be warded off, and the disease thus prevented from making progress. Those who are obliged to remain in this climate during the inclement seasons should avoid exposure to wet and cold, as well as sudden changes of temperature, and night air. Their bedrooms should be warm and well-ventilated; and during cold weather it may be desirable to keep a small fire burning during the night. Heated and badly-ventilated rooms, as well as crowded places of public resort, must be eschewed.

(*d*) *Medicinal treatment.*—There can be no doubt but that the judicious use of certain medicines may assist materially in warding off or mitigating the gouty condition, and in preventing the occurrence of acute paroxysms. Those which are specially called for in cases of established chronic gout will be presently considered. In the meantime, it may be stated that the digestive functions require particular attention, and medicines which promote these functions are often of the greatest service, if they should be disordered, and especially if there should be a tendency to undue formation of acids in the stomach. A course of alkalies or acids, according to the indications in each case, may prove most serviceable, combined with some simple bitter infusion or tincture. Certain alkalies and alkaline earths are also valuable on account of their power in promoting elimination of lithic acid, by forming soluble salts with this acid, which pass away in the urine, and some of them probably act beneficially in other ways. Those which are most useful for this purpose are salts of potash and lithia, but some practitioners prefer magnesia or lime. The best alkaline salts are the citrate or carbonate, or bromide of lithium may be employed, the urate of lithia being the most soluble of all. Soda-salts should not be used, except when it is desired merely to influence the digestive functions. Either of the salts above-mentioned may be employed from time to time, and they must be taken well-diluted, and on an empty stomach. Magnesia or its carbonate may be given with advantage if there is much acidity, and if the bowels are habitually constipated, Saline aperients are often of great service, and they may be beneficially administered in small doses, freely diluted, and regularly repeated, when they also act on the other excreting organs. In many cases other aperients may be employed at intervals with advantage, but strong purgatives must only be used with much caution, and this especially applies to mercurial preparations, which, if taken too freely, may prove highly injurious to patients who have any tendency to gout. The administration of cholagogues from time to time may be of considerable service. Medicines may be given to assist the action of the skin, if this should be defective, such as liquor ammoniæ acetatis.

(*e*) *Mineral Waters and Baths.* — Certain mineral waters are of the greatest value in the treatment of the gouty diathesis, and they offer the advantage that patients will often use them, habitually or at intervals, when they will not undergo a course of regular medicinal treatment; while the water thus taken internally is itself of service. Many of these agents must, however, be employed only under proper medical supervision, otherwise they may do considerable harm. Space will not permit any lengthy discussion of this subject here, and it must suffice to mention that in different cases the kind of mineral water employed must be varied according to the object desired to be accomplished, and according to the indications presented by the patient, for what suits one may be highly injurious to another. These waters are employed both internally and in the form of baths, some of them belonging to the class of thermal waters. Those chiefly used in gouty conditions are the waters of Bath, Buxton, Harrogate, Leamington, and Cheltenham in this country; Strathpeffer and Moffat in Scotland; and Carlsbad, Vichy, Wiesbaden, Baden-Baden, Ems, Royat, Aix-la-Chapelle, Aix-les Bains, Friedrichshall, Hunyadi Jànos, Pullna, Seidlitz, Homburg, Kissingen, Wildbad, Ragatz, Gastein, Elster, Tarasp, Apollinaris, and similar waters from foreign countries. Some of these may be taken regularly or at intervals, for the purposes which they respectively fulfil; or if circumstances permit, a systematic course of treatment from time to time, at certain of the places mentioned, may be recommended. *See* Mineral Waters.

Before leaving the subject of the preventive treatment of gout, it needs to be insisted upon that those who are particularly liable to this disease, whether from their occupation or any other cause, should pay special attention to preventive measures; and also that those in whom the disease has already manifested itself must take every precaution to avoid the known causes of acute attacks, for each attack tends to make matters worse.

2. **Treatment of Acute Gout.**—When a fit of acute articular gout sets in, it is on no account to be permitted to run its course unmodified by treatment, else serious mischief is liable to arise. At the same time it is requisite to refrain from adopting too active measures. Our objects should be to shorten the attack; to restore the affected parts to their normal condition; and to relieve symptoms. In the first place, attention must be paid to the *diet*. The aim should be to make this as low as is compatible with the condition of the patient, especially if the attack presents an acute and sthenic type. In young and strong patients the diet should at first consist of farinaceous substances, a little milk, and abundance of water, barley-water, or toast-and-water. Those who are advanced in years, weak, or broken-down in health, or who have long suffered from gout,

require a more nutritious diet, but it should be easily digestible, consisting of beef-tea and good soups, milk, eggs beaten up, and such articles, the quantities being regulated by the requirements of each case. As the symptoms subside, the food must be gradually improved, fish, fowl, and meat being allowed in succession, but in strict moderation, and due care must be exercised subsequently. If possible, all kinds of alcoholic stimulants should be interdicted, but it may not be desirable to cut them off entirely in some cases, either on account of the previous habits or present condition of the patient, and then it is best to give a definite quantity of brandy or whisky, well-diluted, with the food. For those who cannot take spirits, the writer has found a little good hock or sauterne answer well.

As regards *medicinal* agents, colchicum has long held the most prominent place in the treatment of acute gout, and is regarded almost as a specific. There can be no doubt as to the influence of this drug in relieving the inflammatory symptoms, and shortening the paroxysms of gout, although it is by no means settled how it acts. Its effects must be watched, however, for it does not agree in every case. It has been alleged that colchicum renders the patient more liable to subsequent attacks of gout, but for this notion there does not seem to be any real foundation. The tincture or wine of colchicum may be given in doses of ten to twenty or even twenty-five minims every four or six hours, and either of these may be combined with the citrate or carbonate of potash or lithia, these salts being also of great service in the treatment of acute gout. It is necessary to keep the bowels acting freely by means of suitable aperients, and saline purgatives are of considerable value for this purpose. Other aperients, such as compound rhubarb pill, colocynth, podophyllin, or even calomel or blue pill, may be employed in appropriate cases. Diluents may be given freely, in order to promote the action of the kidneys; and if the cutaneous functions appear to be defective, some mild diaphoretic may be administered, or it may even be desirable to employ the hot-air or vapour-bath. Medicines may be needed for the relief of symptoms, especially pain and sleeplessness, for which Dover's powder or other preparations of opium, chloral, or bromide of potassium may be indicated. In very severe cases hypodermic injection of morphia is of much service.

Venesection ought never to be practised in the treatment of acute articular gout; for although immediate improvement may perhaps be thus produced, the ultimate results are highly unsatisfactory. Even the local removal of blood, by means of leeches applied near an affected joint, is dangerous, and had better be avoided, on account of the permanent local mischief which such a measure is liable to induce.

Local treatment.—The affected parts in acute gout should be kept entirely at rest, and placed in a comfortable position, supported by pillows, and either horizontal or elevated, according to the feelings of the patient. In ordinary cases it is sufficient to wrap up the joints in flannel, or to surround them with cotton-wool completely covered with oil-silk or other impervious material, by which means a kind of local vapour-bath is kept up. If the pain is considerable, local applications must be used, of which the most useful are warm fomentations, to which tincture of opium or belladonna may be added, poppy fomentations, localised steaming, belladonna liniment, tincture of aconite, oleate of morphia, or a solution containing morphia and atropine. Those last-mentioned may be smeared or painted over the surface, or applied by means of lint covered with oil-silk. A blister in the neighbourhood of a gouty joint may be of service, if the attack be asthenic, and also if effusion or much stiffness remain. During recovery, benefit may be derived from careful friction with some stimulating liniment, shampooing, gentle passive movements, douching with salt and water, or the application of a light bandage or elastic support, should there be a tendency to permanent thickening and stiffness, or to œdema and enlargement of the veins.

The acute forms of *irregular gout* must be treated according to their nature, and here it must suffice to offer a few general remarks on the subject. If serious internal symptoms arise, which are distinctly of a gouty nature, and especially if they occur as retrocedent phenomena, it is important to try to excite inflammation in the joints, by means of local heat, friction, and sinapisms. Colchicum may be of service in the non-articular, as well as in the articular form of gout. In painful affections opium or other anodynes are called for; and frequently the administration of alcoholic and other stimulants is indicated, with anti-spasmodics, such as ammonia, ethers, camphor, musk, or belladonna, especially when the stomach or heart is affected. In conditions attended with signs of much depression or collapse, external heat may be applied over the body, or sinapisms to the limbs and over the cardiac region. In the treatment of inflammatory diseases associated with gout much care is required, especially in resorting to depletory measures. The existence of the diathesis must always be borne in mind.

3. **Treatment of Chronic Gout.**—When gout becomes an established chronic disease, the same general rules of treatment are to be observed as in the prevention or attempted cure of the complaint, but they often need modification in particular cases, according to the conditions present. Similar medicines are also indicated, and lithia is particularly valuable, and may even aid in removing gouty deposits; but others may be added to the list, which are suitable in different cases. Thus, colchicum is often of much service, taken habitually or from time to time, in the form of extract at night, or a few minims of tincture or wine two or three times a day, combined with other medicines. Among the many therapeutic agents employed in the treatment of chronic gout under different circumstances may be mentioned benzoic acid or benzoate of ammonia, phosphate of ammonia, phosphate of soda, iodide of potassium, bromide of potassium, carbonate of alumina, lime-juice, guaiacum, ammoniacum, and tonics, especially quinine, tincture or infusion of cinchona, or mild ferruginous

preparations. Undoubtedly most of these are of use in appropriate cases of chronic gout, to serve their special purposes. Symptoms connected with various organs frequently call for attention in this disease, and they must be treated by appropriate remedies. It may be remarked that if diarrhœa should set in in gouty cases, it should not be hastily arrested, as this may be a mode of relief to the system. With regard to the local conditions in chronic gout, it is affirmed that the prolonged use of some of the mineral waters previously mentioned, both internally and in the form of baths, such as those of Aix-la-Chapelle, Aix-les-Bains, and Baden-Baden, may succeed in removing to some extent deposits of urates, and in diminishing stiffness and thickening of joints. For these purposes local measures may also be of service in some instances, provided the morbid changes are not too far advanced, namely, occasional blistering or application of iodine; the prolonged use of wet bandages; friction with liniments; shampooing and passive movements; or systematic compression by means of some plaster. Solutions of alkalies or alkaline carbonates, and especially of carbonate of lithia, have been kept applied to gouty joints and other parts for a long time, under the belief that deposits of urates may be thus dissolved. In the writer's experience no such effect has ever been thus produced, although the constant application of moisture may be useful. Superficial accumulations of urates should not be interfered with unless they become troublesome, when it may be desirable to puncture the skin, and let the contents out. The propriety of removing large masses by operation may come up for consideration, but this should only be attempted if there is every probability that they can be entirely removed without any difficulty, and if the patient is in a fit state for the operation. When abscesses or ulcers form, they come under the treatment of the surgeon; but it may be observed that simple dressings usually answer best in these cases, and they may sometimes be advantageously dressed with solution of carbonate of potash or lithia. It must not be attempted to heal them up too rapidly, as the discharge may be a relief to the system, and it may even be necessary to enlarge the opening of an abscess. Under any treatment it is by no means an easy matter to induce gouty sores to heal.

The treatment of the various chronic organic diseases which are liable to arise in the course of gout must always be kept in mind, but the reader is referred to other appropriate articles for a consideration of this part of the subject.

FREDERICK T. ROBERTS.

GRAND MAL. (Fr.)—A term applied to epilepsy when it assumes the form of a severe convulsive attack. *See* EPILEPSY.

GRANULAR KIDNEY.—A morbid condition of the kidney, in which this organ is the seat of fibroid change, and as a result becomes contracted, hard, and granular. *See* BRIGHT'S DISEASE.

GRANULAR LIVER.—A synonym for cirrhosis of the liver, in which the organ presents a granular appearance, on its surface and on section. *See* LIVER, Diseases of.

GRANULATION (*granulum*, a little grain). In medical pathology, granulation is synonymous with tubercle in its isolated form, the individual tubercles being called 'grey' or 'yellow' granulations, according to their appearance. *See* TUBERCLE. In surgical pathology, the term granulations is applied to small vascular prominences, consisting of embryonic tissue, growing on the surface of wounds or ulcers, and by which the healing process is carried on—whence the expression 'healing by granulation.' When granulations assume the appearance of an exuberant growth they constitute what is called 'proud flesh' (*see* CICATRIZATION, and ULCER.)

GRANULIE (French).—A synonym for tuberculosis. *See* TUBERCULOSIS.

GRAVEDO, (*gravis*, heavy).—A synonym for common catarrh; so applied on account of the sensation of weight in the head present in that affection. *See* CATARRH.

GRAVEL. — DEFINITION. — The deposit in, and escape from the urinary passages of gritty particles with the urine.

ÆTIOLOGY.—The same causes which produce dyspepsia are frequently productive of lithic acid gravel, such as indolent habits, excess of food and drink—especially of nitrogenous and saccharine articles, and the too free indulgence in the use of fermented liquors. Endemic causes connected with climate and the nature of the drinking water, hereditary predisposition, and many slight or serious organic diseases, may explain the appearance of gravel in those, and especially in women, who commit no dietetic excess, or who are total abstainers. *See* OXALIC ACID DIATHESIS, PHOSPHATIC DIATHESIS, and URIC ACID DIATHESIS.

VARIETIES.—Gravel may be composed of (1) lithic acid and its compounds; (2) oxalate of lime; (3) phosphate of lime; or (4) the triple phosphate of lime, magnesia, and ammonia. By far the most common form of gravel, and that which alone need now be considered, is the lithic acid. This, owing chiefly to its great insolubility, is frequently deposited in the kidney and bladder, and is seen in the newly-passed urine in the form of the well-known reddish-brown crystals, often described as resembling Cayenne pepper grains. The supernatant urine is generally clear, rather dark in colour, and of a distinctly acid reaction.

SYMPTOMS.—The passage of uric-acid crystals or gravel frequently causes no subjective symptoms, and is consistent with perfect health. Sometimes, however, it gives rise to, or is accompanied by, both general and local disturbance of function. The general symptoms are those of dyspepsia, namely, flatulence and heartburn after meals, eructations, headache, muscular cramp, depression of spirits, and a sense of malaise. Locally, there is dull aching in the lumbar region, not increased by movement; frequent micturition; a sense of heat and irritation at the neck of the bladder and along the urethra, especially during and after voiding water; and sometimes the appearance

of a faint cloud of mucus or a slight tinge of blood in the urine.

Treatment.—From what has been said, it follows that the most important points in the treatment of gravel are strict limitation as to the *quantity* of food; the avoidance of highly-seasoned, very rich, or sweet dishes; the preference for vegetable rather than for animal food; abundant exercise in country air; and the absence or very sparing use of alcoholic liquors. Medicinally there may be given diuretics, to increase the quantity of the urine and facilitate the escape of gravel; pure water, alkalis, and alkaline waters freely diluted, to act as solvents of uric acid; and saline aperients and saline waters, to promote digestion and assist in ensuring the free action of the liver and alimentary canal.

W. Cadge.

GRAVES' DISEASE.—A synonym for exophthalmic goître, to which the late Dr. Graves of Dublin called special attention. *See* Exophthalmic Goître.

GREEN-SICKNESS.—A popular synonym for chlorosis, applied on account of the greenish colour of the skin sometimes present in that disease. *See* Chlorosis.

GRIPPE (Fr.)—A French synonym for influenza. *See* Influenza.

GROWTH, Disorders of.—*See* Atrophy, Hypertrophy, and Malformations.

GRUTUM.—A term applied to small, hard, white globules developed from the epidermis, and commonly met with on the face, especially on the eyelids, cheeks, and temples. They are called grutum, from bearing some resemblance to oatmeal *grits*; and have likewise been named *milium*, as comparing them in size and roundness of figure to millet-seeds. Other of their synonyms are *miliary tubercles* and *pearly tubercles*.

Erasmus Wilson.

GUINEA-WORM.—Synon.: Dracunculus; *Filaria medinensis*. Supposed by some persons to be the 'fiery serpent' of Mosaic history.

Description.—The Guinea-worm is a nematoid parasite, usually measuring from one to three feet in length, and having a breadth of about one-tenth of an inch. Examples have been described as reaching six feet in length. In the adult condition it infests the feet and legs, as well as other parts of the body that are much exposed. The female only is known, but its more or less finely pointed and subulate tail has often caused it to be described as the male parasite (by Owen and others). The anatomy of the worm has been described by Busk, Carter, and Leuckart, and more particularly by Bastian, who has also thrown much light upon the structure and development of the embryos as they are found within the body of the parent worm (*Linn. Trans.* 1863, p. 101 *et seq.*) The discovery of the viviparous mode of reproduction of the dracunculus is probably due to Jacobson, whose observations were subsequently verified by Owen, Busk, Bastian, the writer, and also by Robin, Carter, Davaine, and Moquin-Tandon. As regards the development of the worm outside the body of the parent, the only observations of importance are those of the Russian traveller, Fedschenko. According to the deceased *savant* (as verbally communicated to the writer during his visit to England), the escaped embryos of the Guinea-worm perforate the skin of minute aquatic crustaceans (Cyclops). Here, after a period of only twelve hours, the embryos undergo a first change of skin, parting with their long fine tails, which eventually become comparatively blunt and forked. At the expiration of one month and six days they acquire their highest larval stage of growth within the Cyclops, traces of the reproductive organs being already seen; and thus, along with the intermediate hosts, as young males and females, they are transferred to the human stomach. Fedschenko expressed his belief that it was either in the stomach or in the intestine that they subsequently copulated, producing a progeny after the manner of Trichina; the males perishing and passing away per anum, whilst the females migrated through the tissues towards the surface of the body. Whether or not this view be correct, Fedschenko's discovery of the fact that the dracunculus needs to pass through the body of an intermediary bearer loses none of its practical and scientific interest. In Dr. Bastian's opinion the young dracunculi are the product of a non-sexual process. It should not be forgotten that Dr. Carter, who is a great authority on all matters connected with the natural history of the guinea-worm, has stated that in a school of fifty boys bathing in a pond, the sediment of which swarmed with microscopic tank-worms (*Urobales palustris*), no less than twenty-one were attacked with dracunculus *during the year*; whilst the boys of other schools, bathing elsewhere on the island of Bombay, were, with one or two individual exceptions, not affected. Facts of this kind long led the writer and others to suppose that sexual maturity was attained prior to the entrance of the worms into the human bearer. Thus, the writer has stated it to be probable (*Entozoa*, 1864, p. 388) that 'the sexes associate in muddy waters during the monsoon, after which act the males perish, whilst the females are left to find their opportunity for a mode of direct entrance into and further development within the human body.' It is clear that some waters are more infested by young guinea-worms than others. It is also tolerably certain that human infection is due to the passive immigration of the parasites. We fear, however, that the notion of ingress in a direct manner through the ducts of the skin must now be abandoned. Its former acceptance appeared to be in entire harmony with the data supplied by Indian army surgeons and other observers.

The geographical distribution of the guinea-worm is limited to inter-tropical climates, being, for the most part, confined to certain districts of Asia and Africa. It occurs also in the island of Curaçoa and in Brazil. [On this subject *see* Dr. J. F. da Silva Lima's Memoir in *The Veterinarian* for February, 1879.] It is endemic in its action; all races of mankind, without reference to age or sex, being liable to be attacked in the guinea-worm districts.

Treatment.—Clinically speaking, the mode of treatment pursued at the present day does not differ materially from the old method adopted by the Persian surgeons, who extracted the worm

by gentle and continuous traction, winding the exposed end of the worm round a small stick of ivory, bone, or wood. If the parasite be ruptured, local and even severe constitutional mischief is apt to ensue. *See* DRACUNCULUS.

T. S. COBBOLD.

GUMMA (Lat., gum).—A growth occurring in syphilis, so named on account of its supposed superficial resemblance to gum. *See* SYPHILIS.

GUMS, Diseases of.—*See* MOUTH, Diseases of.

GURGLING.—A physical sign heard on auscultation of the chest or abdomen in certain conditions, due to the movement of gas and fluid within a cavity, whether normal or abnormal. A gurgling sensation may also be felt at times in the intestines, as over the cæcum in typhoid fever. *See* PHYSICAL EXAMINATION.

GUTTA ROSACEA (*gutta*, a drop; *rosacea*, rosy).—A synonym for Acne rosacea. *See* ACNE.

GYMNASTICS (γυμνός, naked). *See* EXERCISE.

GYNÆCOLOGY (γυνή, a woman, and λόγος, a word).—This term in its literal sense means a doctrine or discourse concerning women. In medical language, it comprehends the study of the diseases peculiar to women. *See* WOMEN, Diseases Peculiar to.

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HABIT OF BODY.—This expression signifies the sum of the physical qualities of an individual, and is sometimes used synonymously with *constitution*. Thus we speak of a *full* habit, a *spare* habit, and an *apoplectic* habit.

HABITS. *See* DISEASE, Causes of; and PERSONAL HEALTH.

HÆMACYTOMETER (αἷμα, blood, κύτος, a cell, and μέτρον, a measure).—DEFINITION.—An instrument by the aid of which the number of corpuscles contained in a given volume of blood can be ascertained.

DESCRIPTION.—All methods employed for this object consist in making a definite dilution of a certain quantity of blood, and counting the number of blood-corpuscles in a certain volume of this dilution. Vierordt, who originated the method, drew uniform lines of diluted blood upon a slide, and, after it was dry, counted the corpuscles in a certain length of line. Cramer substituted for these lines what may be termed a capillary cell; and Potain and Malassez employed a capillary tube, and a microscope provided with an eyepiece ruled in squares. Hayem substituted for the tube a cell, the depth of which gave one dimension of the volume of dilution, while the lines upon the eyepiece furnished the others. The writer's instrument is an adaptation of Hayem's, with certain modifications; the diluting apparatus is similar, but of different capacity, and the lateral dimensions of the volume of dilution are obtained, not by a microscope-eyepiece, but by lines engraved upon the glass slide at the bottom of the cell. The instrument can thus be used with any microscope, an important convenience in practical use. The alteration in the capacity of the diluting measures facilitates the counting, and provides a much simpler mode of statement of the result. The apparatus, which is made by Hawksley, consists of (1) a pipette graduated to 995 cubic millimeters for measuring the diluting solution, (2) a capillary tube for measuring the blood containing five cubic mm.; (3) a small glass jar and stirrer for making the dilution; and (4) the cell for counting, ·2 mm. deep, and ruled at the bottom in squares, each ·1 mm. in length and breadth. The slide bearing the cell is fixed on a small metal plate, to which two springs are attached; these keep the cover-glass in position when applied.

Various solutions have been employed for making the dilution. That which the writer has found to answer best, as differentiating most clearly the red and white corpuscles, consists of sulphate of soda, 104 grains; acetic acid, 1 drachm; distilled water, 6 ounces.

In using the hæmacytometer, a drop of the dilution is placed in the centre of the cell; the cover-glass and springs are applied; and in a few minutes the corpuscles have sunk to the bottom of the cell, and are seen lying within the squares. The dilution of 5 cmm. of blood in 995 cmm. of solution is 1 in 200; each square contains the corpuscles from a volume of dilution ·2 mm. in one, and ·1 mm. in each of the other dimensions —that is, 2 cubic ·1 mm., or the ·002 part of a cubic mm. But the dilution being 1 in 200 this volume of dilution contains just ·00001 cm. of blood. The number of corpuscles in a square multiplied by 100,000, is thus the number in a cubic millimeter of blood—the common mode of statement. In order to limit error, the number of corpuscles in ten squares should be counted, and this number multiplied by 10,000 is the number per cubic millimeter. The average number in health is about 5,000,000. Blood of normal richness, then, contains about 50 corpuscles per hæmacytometer square. Therefore the number in two squares of the instrument will always represent the proportion of the corpuscular richness to normal blood(=100)—that is, the percentage proportion to normal. It is, there-

Leit' Count corpuscles in 5 squares. Divide total by 5×16, and multiply by 800000 = no per cm.

fore, convenient to take the volume of blood represented by the two squares ('00002 cubic millimeter) as the standard volume, or 'hæmic unit.' For instance, it is found that the blood diluted presents in ten squares 375 corpuscles or 75 in two squares ('hæmic unit')—that is, 75 per cent. compared with the normal. To learn the number per cubic millimeter we have only to multiply 375 by 10,000, = 3,750,000. In counting the white corpuscles, if they are not in considerable excess, it is most convenient first to ascertain the number of red corpuscles per square, and note how many squares are contained in a field of the microscope. If then the focus is raised so that the corpuscles are becoming indistinct, the white ones, from their higher refracting power, will appear like bright points, and the number in a series of fields can easily be counted. For example, the number of red corpuscles per square has been found to be 40, and the field contains 15 squares, that is, 600 corpuscles per field. Ten fields contain 15 white corpuscles; the proportion of white to red will, therefore, be 1 to $\frac{600 \times 10}{15}$ = 1 to 400.

With this apparatus we may readily ascertain, within a small limit of unavoidable error, the corpuscular richness of the blood, an important element in many morbid states, such as anæmia; and we can thus ascertain the indications for, and observe the effect of, therapeutic agents. It is, however, very desirable in these cases to ascertain also the richness of the corpuscles in hæmoglobin (*see* HÆMOGLOBINOMETER). The instrument may also be employed for ascertaining the globular richness of milk or other liquids. W. R. GOWERS.

HÆMATEMESIS (αἷμα, blood, and ἐμέω, I vomit).—SYNON.: Fr. *Hématémèse*; Ger. *Blutbrechen*.

DEFINITION.—Vomiting of blood, dependent on a variety of morbid conditions.

ÆTIOLOGY AND PATHOLOGY.—Hæmorrhage into the stomach may arise—1. From the laying open of an artery. 2. From venous or capillary congestion of the mucous membrane. 3. From causes affecting the blood itself, so that it tends to transude through the vessels under pressure of the circulation.

1. The most frequent cause of hæmatemesis is an ulcer of the stomach. It occurs, according to the late Dr. Brinton, in about one-third of all the cases of gastric ulcer that come under treatment. The bleeding usually takes place shortly after a meal, and the quantity rejected varies greatly. In some cases, it is so small that it may require careful examination to discover it; whilst in others enormous quantities are vomited, and often also passed through the bowels. The splenic artery is most frequently the source of the bleeding, but it may arise from the coronary, the superior pyloric, or, more rarely, from the blood-vessels of some of the neighbouring organs, such as the pancreas, liver, or spleen, to which the stomach has become attached, and which may happen to form the base of the ulcer. It is not necessary that the ulcer should be of large size to produce hæmorrhage. Although it is most apt to occur in chronic cases, instances have been recorded in which a large vessel had been laid open by an ulcer so small as to require careful search for its detection. It must be borne in mind that extensive bleedings may take place without any vomiting, and the source of the fatal illness be overlooked. Such cases are not of infrequent occurrence, and warn the practitioner that he should be on the alert, whenever signs of hæmorrhage present themselves, and that he should not rely too much on the absence of pain and vomiting. In cancer of the stomach profuse hæmorrhage is less common than in simple ulcer; the larger vessels being probably compressed by the new growth, which ordinarily commences in the submucous tissue immediately above them. But a constant oozing of blood is, on the contrary, more common than in simple ulceration. This blood, acted on by the gastric juice, constitutes the 'coffee ground' vomiting of the older authors. Its occurrence used to be looked upon as pathognomonic of malignant disease, but it is now known that its presence only shows that the bleeding has taken place slowly and in small quantities at a time. Occasionally profuse hæmorrhage takes place from the rupture of an aneurism into the stomach; and in a case which came under the writer's notice at the London Hospital, fatal vomiting of blood resulted from the perforation of the aorta by a fish-bone that had become impacted in the œsophagus.

2. Congestion of the portal system is a very frequent cause of hæmatemesis. The most marked and fatal cases of this kind occur along with plugging of the vena portæ or its large branches with blood-clots or cancerous matter. Such cases are very rare, and vomiting of blood, arising from venous congestion, ordinarily results from cirrhosis, chronic congestion, and other diseases of the liver, in which the portal circulation is obstructed. More rarely the like occurrence is observed in persons suffering from diseased heart, especially where there is narrowing of the mitral orifice. In such cases, there is generally a co-existence of chronic catarrhal gastritis, and in all probability the bleeding takes place from the hæmorrhagic erosions so common in that condition. In one form of this disease enormous quantities of mucus are discharged. Sometimes there is considerable bleeding in these cases, but they are distinguishable from ulcer by the absence of pain; by the vomiting being only occasional; and also by the fact that the blood-stained vomit generally follows a profuse evacuation of colourless mucus, and is always of a dark colour. In females thus affected the catamenial discharge is generally profuse; and the attacks of vomiting do not necessarily coincide with the menstrual periods. It has always been held that hæmatemesis may replace the menstrual discharge. Without denying this, the writer has never met with a well-marked case of the kind. Hæmatemesis due to acute congestion is also a constant result of irritant poisoning.

3. Hæmatemesis also arises from causes affecting the blood, and predisposing it to ooze through the walls of the veins or capillaries. It occurs in this way in purpura, yellow fever, and in some cases of typhus. In jaundice, where bleeding

from the gums and other mucous membranes is so often observed, life may be suddenly destroyed by hæmatemesis. Occasionally a hæmorrhagic tendency manifests itself suddenly, without apparent cause, as in a case observed by the writer, in which a woman, about fifty years of age, was affected with severe bleeding from the nose, followed by excessive menstrual discharge, on the cessation of which profuse hæmatemesis took place, from which she sank. She had no jaundice nor other apparent cause for her illness, and after death the most careful scrutiny failed to detect disease in any organ. To this class of causes we should probably refer the hæmatemesis occurring in acute atrophy of the liver, and in pyæmia, as, in all probability, the oozing of blood through the vessels arises from changes effected in its chemical or physical composition.

Symptoms.—Generally the patient in hæmatemesis is suddenly attacked with faintness, accompanied by a feeling of weight at the pit of the stomach, the countenance is pale, the pulse feeble and compressible, and in some cases actual syncope occurs. This state terminates by vomiting, and a greater or less quantity of blood is rejected from the stomach. When a large blood-vessel has been laid open, and the bleeding has taken place rapidly, the blood may be florid; but generally the hæmorrhage goes on so slowly that time is given for the action of the gastric juice upon it, and consequently it is of a dark colour. It is not often that the stomach is completely emptied, or perhaps the bleeding persists in small quantities after the vomiting has ceased, so that the stools are generally of a dark or pitchy character, from the admixture of blood that has passed into the intestines. The hæmorrhage may cease soon after the stomach has been emptied, or the vomiting of blood may recur from time to time, or—and this is very apt to occur in gastric ulcer—months or years may elapse before it again takes place.

Diagnosis.—In some cases, when the blood has been slowly effused into the stomach, there may be difficulty in determining whether the dark colour arises from bile or blood. The microscope or spectroscope will be enough to settle this point; or the liquid may be boiled with alcohol, and tested for the biliary salts. It is not always easy to ascertain whether the blood has come from the lungs or from the stomach, as the patient is sometimes so much alarmed that he cannot say whether it was brought up by coughing or vomiting. As a general rule, the blood from the lungs is florid, mixed with mucus, alkaline, and frothy; that from the stomach of darker colour, intermixed with particles of food, and in masses. Again, hæmoptysis is generally preceded by symptoms referable to heart or lungs, such as cough, expectoration, and dyspnœa; hæmatemesis by the symptoms indicative of gastric or hepatic disease, such as those described above.

Prognosis.—As a general rule this is favourable in hæmatemesis, more especially in first attacks. Dr. Brinton calculated that death resulted from this cause in only 3 to 5 per cent. of the cases of gastric ulcer; and it is still less frequently fatal where it proceeds from hepatic congestion or cirrhosis. Still, the possibility of the bleeding arising from flooding of the portal vein, from the opening of a large artery, or from the bursting of an aneurism, should be kept in view, and the patient carefully watched.

Treatment.—Where a large quantity of blood has been ejected from the stomach, the treatment must be prompt and decided. The patient should be maintained in a recumbent posture, and kept perfectly quiet. All food must be forbidden, and pieces of ice placed in the mouth to suck. If faintness be present, it is better not to give brandy, which almost always brings on vomiting, but to apply ammonia to the nostrils; or, if necessary an enema containing brandy may be given.

The best styptics are gallic acid, alum, and acetate of lead. The gallic acid may be given in 10-grain doses, along with 10 or 15 minims of dilute sulphuric acid, and should be repeated frequently. Alum may be prescribed in infusion of roses; and the acetate of lead in 2-grain doses in the shape of a pill, or combined with acetic acid. Oil of turpentine is also used. Where the bleeding is slight, and there is good reason to believe it arises from portal congestion, the best treatment is to give a small dose of calomel, followed by sulphate of magnesia and dilute sulphuric acid in infusion of roses every three or four hours, until purging is produced.

For some days after severe hæmatemesis, the strictest quiet should be maintained; and, in the case of ulcer of the stomach, opium should be used, and the diet most carefully regulated; if rendered necessary by persistent bleeding, nutritive enemas should be substituted for food by the mouth, and all purgatives avoided. When the hæmorrhage has arisen from portal congestion, a free action on the intestinal canal should be commenced in a few days after the cessation of the hæmorrhage, so as to diminish the amount of blood in the venous system of the alimentary organs.

S. Fenwick.

HÆMATHIDROSIS (*αἷμα*, blood, and *ἱδρῶς*, sweat).—Bloody sweat. *See* Perspiration, Disorders of.

HÆMATHORAX. *See* Hæmato-thorax.

HÆMATIN.—*See* Hæmoglobin.

HÆMATINURIA, PAROXYSMAL (hæmatin; and *οὖρον*, the urine).—Synon.: Hæmoglobinuria.

Definition.—A paroxsymal affection of the system; manifesting itself by changes in the urine; caused sometimes by malaria, and sometimes by other conditions not yet determined; consisting in no anatomical change as yet recognised; and characterised by the occasional occurrence of constitutional disturbance, with discharge of dark, blood-stained urine.

Ætiology.—The most important extrinsic cause of the tendency to this disease is malarious poison, the most important cause of the paroxysm is exposure to cold or wet; but the tendency may exist without malarial poison, and the attack may occur apart from any special exposure. Amongst intrinsic causes, sex is evidently important, for the disease is almost confined to males. It may occur in children, and may occasionally recur during a period of years.

Anatomical Characters.—The disease not being fatal, there is no evidence as to the existence of any anatomical change in the kidneys.

Symptoms.—Hæmatinuria is paroxysmal, but not distinctly periodic. It may commence in childhood or during adult life. The attacks may occur once, twice, or thrice a day, on alternate days, once a week, or quite irregularly. The paroxysm may commence abruptly without any premonitory symptom, but is more commonly ushered in by a feeling of uneasiness in the loins and limbs, by shivering, and general chilliness. Sometimes it is preceded by slight jaundice, furred tongue, and other symptoms of gastric catarrh; and sometimes albuminuria precedes by a few hours or a day the occurrence of hæmatinuria. The more abrupt attacks frequently terminate by the discharge of the peculiar urine, and the next urine is normal, or nearly so. In some cases albuminuria lingers for a time after the discoloration has passed off. The characters of the urine are very peculiar. Its colour is like porter, or like muddy port wine; its specific gravity ranges from 1015 to 1035; it is acid, or faintly alkaline; highly albuminous; sometimes it contains excess of urea; and throws down a copious sediment. This contains very few or no blood-corpuscles, but an immense amount of granular blood-pigment, with numerous tube-casts—hyaline or epithelial, often loaded or coated with amorphous granular matter, and with minute crystals of oxalate of lime. The colour is not due to blood-corpuscles, and it is said not to be due to hæmatin, but to hæmoglobin. In some cases the urine is less affected, being merely albuminous, and not depositing pigment. It may be doubted whether this condition should be admitted to the same category as the disease under discussion, but cases which have come under the writer's observation seem to show that it is entitled so to rank.

Diagnosis.—The only diseases with which intermittent hæmatinuria is likely to be confounded are hæmaturia, and renal calculus or gravel. From the former it is distinguished by the abundance of the blood-pigment, and the extreme rarity of blood-corpuscles; from the latter by the short duration of the attacks, the presence of the characteristic deposit, with the fact that the pains affect both loins, not merely one. It is sometimes important to distinguish the milder forms, in which merely albuminuria occurs, from congestion or from commencing inflammatory Bright's disease. It is not always possible to distinguish these during the early hours of the attack; but the amount of general disturbance, the state of the tongue, the slight jaundice, the suddenness of the onset, and the absence of dropsy, generally suffice to make it clear.

Prognosis.—The prognosis is good in paroxysmal hæmatinuria, as to the individual paroxysm. The tendency to the disease is also not unfrequently got rid of. It has not proved fatal in any case. But it appears sometimes to usher in, or to constitute, an early symptom of Bright's disease—the cirrhotic form.

Treatment.—As the paroxysm is spontaneously recovered from, little need be done, excepting with the view of alleviating the discomfort of the patient. He should go to bed and be kept warm, and have abundance of warm drinks. In respect of diminishing or removing the tendency to the malady, various remedies have been found useful, among which may be mentioned quinine, tincture of cinchona, iron, arsenic, and chloride of ammonium.

T. Grainger Stewart.

HÆMATOBIUM (αἷμα, the blood, and βίος, life).—A synonym for hæmatozoon. *See* Hematozoa.

HÆMATOCELE (αἷμα, blood, and κήλη, a tumour).—Synon.: Fr. *Hématocèle*; Ger. *Blutgeschwulst*.—Definition.—The swelling occasioned by effusion of blood in the sac of the tunica vaginalis, or in a cyst connected with the testicle.

Ætiology and Symptoms.—The extravasation of blood in hæmatocele may take place in a healthy state of the parts, or it may succeed or be combined with hydrocele. In both cases it may be occasioned by a blow, or by violent efforts made in straining, especially in old persons, or when the blood-vessels are diseased. It may happen also from the accidental wound of a vessel in tapping a hydrocele. The blood effused, if small in quantity, mixes with the fluid of the hydrocele, occasioning slight enlargement without disturbance. If it be large in quantity, coagula are formed; inflammation is excited in the tunica vaginalis; and plastic exudation occurs on its inner surface, sometimes forming layers, and rendering the sac extremely dense and firm.

The testicle preserves the same relation to the remainder of the tumour as in hydrocele, being situated at its posterior part. Its position, however, is liable to similar alterations as occur in hydrocele, which are very difficult of detection, owing to the great thickening of the parts.

Diagnosis.—A hæmatocele may be distinguished from a hydrocele by the absence of transparency; the obscure character of the fluctuation; the heavy feel of the tumour when balanced in the hand; and the sudden and accidental mode of its occurrence. In old chronic cases, in which the tunica vaginalis and its envelopes have become much thickened and indurated, the tumour possesses so firm a character, and feels so heavy and solid, that it is very liable to be mistaken for a chronic enlargement of the testicle; and the diagnosis, at all times difficult, in some instances cannot be satisfactorily made out by the most experienced hands. The records of surgery furnish many cases in which castration has been performed owing to a mistaken diagnosis. When doubt exists, it should be removed by the introduction of a trochar or by an incision before any serious operation, such as castration, is undertaken.

Treatment.—When hæmatocele succeeds a hydrocele, the blood, if small in quantity, mixes with the fluid of the hydrocele without producing irritation. The tinged fluid may be removed by tapping, and the operation can be repeated afterwards at intervals until the fluid is free from discoloration. Even when inflammation arises, if the sac be tapped and tension removed, and the patient be kept at rest, with ice applied to the part, the inflammation may subside. When however, the blood effused is large in quantity and when the inflammation is acute and threatens suppuration, the tumour should be punctured a

its upper part, a director introduced, and the sac freely laid open by incision. This must be done with care, so as to avoid wounding the testicle. A chronic hæmatocele with a very thickened sac must be cut into in the same way; and lateral portions of the sac may be excised, so as to lessen the wound for healing. The practitioner must bear in mind that the testicle is sometimes situated in front, as in cases of inversion, and is then very liable to injury in the operation of incision, and even in tapping.

Encysted hæmatocele.—Encysted hæmatocele implies an effusion of blood in the sac of an encysted hydrocele; and the treatment is the same as that required for ordinary hæmatocele.

Hæmatocele of the Cord.—Blood may also be effused in the areolar tissue of the spermatic cord, constituting *diffused* hæmatocele of the cord; or in a cyst in the cord, constituting *encysted* hæmatocele of the cord. Such cases are very rare. T. B. Curling.

HÆMATOIDIN.—*See* Hæmoglobin.

HÆMATOMA (*αἱματόω*, I fill with blood).—A peculiar form of bloody tumour, or a collection of extravasated blood that has undergone certain changes. It is observed more especially in connection with the ear, the scalp, and the meninges. *See* Cephalhæmatoma; Hæmatoma Auris; Meninges, Cerebral, Hæmatoma of; and Tumours. The term is sometimes also applied to fungus hæmatodes.

HÆMATOMA AURIS (*αἱματόω*, I fill with blood; *auris*, of the ear).—Synon.: The Insane ear; Fr. *Othématome*; *Hématome de l'oreille des aliénés*; Ger. *Othämatoma*; *Ohrblutgeschwulst von Geisteskranken.*

Definition.—An affection of the auricle, which occurs almost, if not quite exclusively, in the insane, and consists in the effusion of blood or bloody serum between the cartilage and its perichondrium, to such an extent as to form a distinct tumour.

Ætiology.—In most of the few cases of hæmatoma auris which have been published to show that this disease may occur in the sane, the description given of the patients rather points to their insanity than otherwise. It is most common in cases of general paralysis and mania (acute and chronic), but also occurs in melancholia, dementia, and idiocy. It is about four times as frequent in men as in women; and more often affects the left ear than the right. Sometimes both ears are affected, but seldom at the same time. There would seem to be, in many or all of the insane, a morbid condition of the vessels or other tissues of the auricle, which predisposes to the occurrence of hæmatoma. If this condition be present to a sufficient degree, the disease may arise spontaneously; in other cases a very slight injury may be sufficient to cause it; whilst in others very considerable violence is necessary for its production.

Symptoms and Course.—The disease first makes itself evident by the appearance of a swelling of about the size of a horse-bean; this is almost always upon the anterior surface of the pinna, and usually in the neighbourhood of the fossa of the antihelix. The skin over the tumour is generally of a reddish or bluish-red colour, but may be unaltered at first; the temperature of the ear is sensibly raised; the swelling is very painful and tender; there is no extravasation of blood from the cutaneous vessels; and the tumour is not œdematous. At this stage, the effusion which has taken place between the cartilage and its perichondrium consists of dark red fluid blood. In rare cases the swelling does not increase further; the inflammatory symptoms subside after about a week; absorption gradually takes place; and only a slight thickening remains. More usually the tumour increases and may attain the size of a hen's egg; it becomes tense, elastic, distinctly fluctuating, and hot; and is often of a bright red colour. Its prominent anterior wall, consisting of skin, cellular tissue, and perichondrium, is felt to be thinner and less resisting than the posterior, which contains the ear-cartilage. In certain cases, however, owing to the brittle cartilage having split up, and portions of it having adhered to either wall, both walls present irregularly alternating characters. The time which a hæmatoma takes to attain its largest size varies from a week to a month; it then generally involves the whole of the concha, occluding the external auditory meatus; the folds of the auricle are lost, with the exception of the helix (which appears as a band running round the tumour), and the dependent lobule. The weight of the tumour causes the whole ear to fall somewhat forwards and outwards. Sometimes, especially in the presence of constant or repeated irritation, the inflammatory stage may last many weeks, and the deformity which always results from the affection is thereby greatly increased. Unless subjected to violence, it very rarely happens that the tumour opens spontaneously, although its tense and inflamed appearance often seems to indicate that such an occurrence is imminent. If rupture does take place, suppuration ensues; portions of cartilage come away, the cavity closes very slowly; and great deformity results. The most common course is for the inflammatory symptoms gradually to subside. The anterior wall becomes firmer, owing to a new deposit of cartilage upon its inner surface; the sense of fluctuation is gradually lost; and the tumour slowly diminishes in size, often yielding a somewhat doughy sensation to the touch. Occasionally, at this stage, some gaseous contents have been observed in the cavity. The colour of the skin over the tumour becomes gradually more dusky; it then passes into yellow and, later on, into an unnatural pallor. As the fluid contents become absorbed, the tumour becomes harder and smaller; folds again appear in the auricle, but do not correspond to the original ones; and the pinna remains permanently thickened, puckered, and often nodular.

Anatomical Characters.—Many of these have been given above in explanation of symptoms, and do not require to be repeated. A shrivelled auricle, which has previously been affected by hæmatoma, presents, on section, two distinct layers of cartilage; these are of varying thickness, and separated from each other by vascular fibrous tissue, which often contains within it other small isolated plates of cartilage, and sometimes also small portions of bone. The fibrous tissue is the organised product of the original

effusion; the two layers of cartilage have been developed upon the inner surfaces of the perichondrium; the loose portions of cartilage and bone which are occasionally seen, are developed from the fibrous tissue. It used to be supposed that the bone (which is soft, vascular, and contains well-developed Haversian systems) resulted from ossification of the ear-cartilage; but the writer has shown elsewhere (*Brit. Med. Journal*, Oct. 1873) that this is not the case.

PROGNOSIS.—The local affection is in no way dangerous, but it always leaves behind it a permanent characteristic deformity of the auricle. The sense of hearing is only affected by the occlusion of the auditory meatus; but this condition very rarely persists after the acute stage. The occurrence of hæmatoma auris affects the prognosis of the mental disease unfavourably, but does not necessarily indicate the approach of a fatal termination to the case.

TREATMENT.—Protection of the part from injury is usually all that is necessary. Cooling applications might be useful if inflammation were excessive. The tumour should not be opened; nor should a portion of the anterior wall be removed, as has been recommended; these procedures only lead to suppuration. It is useless to empty the cavity by aspiration, as it fills again with great rapidity. The treatment by pressure is very painful, and yields no good result.

CHAS. S. W. COBBOLD.

HÆMATO-PERICARDIUM (αἷμα, blood; περὶ, about; and καρδία, the heart).—An extravasation of blood into the sac of the pericardium. *See* PERICARDIUM, Diseases of.

HÆMATO-THORAX (αἷμα, blood, and θώραξ, the chest).—An extravasation of blood into the pleural cavity. *See* PLEURA, Diseases of.

HÆMATOZOA (αἷμα, blood, and ζῶον, an animal).—This term is of general application to all kinds of animal parasites dwelling in the blood and blood-vessels; but its employment is often restricted to certain of the nematoid entozoa, which display this habit in a more marked degree than the other parasites are wont to do. All classes of helminths are liable, at some time or other in the course of their lifetime, to take up their residence in the blood, but in the case of the *Tæniæ*, or rather of their *proscolices*, this period is of very short duration. One or two species only of fluke-worms or trematodes play a similar *rôle* in man, the most important being the *Bilharzia*, which gives rise to an endemic hæmaturia at the Cape, and elsewhere in Africa (*see* BILHARZIA). Our knowledge of the nematoid hæmatozoa dates at least as far back as the time of Ruysch (1665) who was acquainted with the strongyles which produce aneurism in the horse and other solipeds; whilst more than half a century later the subject received additions from the writings of Schulze (1725) and Chabert (1782); and subsequently from the memoir by Rayer (1843). About the latter period also the observations by Grube and Delafond 'on a verminiferous condition of the blood of dogs, caused by a great number of hæmatozoa of the genus *Filaria*,' excited much attention; but until quite recently it was not so much as suspected that similar microscopic filariæ infested the human body. In 1872 Dr. Lewis announced the important discovery of the existence of nematoid worms in the living human subject also. *See* CHYLURIA; and FILARIA SANGUINIS-HOMINIS.

T. S. COBBOLD.

HÆMATURIA (αἷμα, blood, and οὖρον, urine).—SYNON.: Fr. *Hématurie*; Ger. *Blutharnen*.

DESCRIPTION.—Hæmaturia is a symptom of many different morbid conditions of the system, and of the urinary tract. The quantity of blood discharged in the urine varies greatly, and the appearance of the urine corresponds. Sometimes it is dark, loaded with clots; sometimes it is merely smoky, or of a faintly pink hue. It is albuminous, and corpuscles (often altered by soaking in the urine) may be discovered by the microscope, sometimes becoming swollen, sometimes shrunken. The following are the best tests for detecting the presence of blood in the urine.—1. *Guaiacum*. When equal parts of tincture of guaiacum and oil of turpentine are shaken together to make an emulsion, and the urine is cautiously added, an intense blue colour is produced if blood be present. 2. *Spectrum analysis*. Very minute quantities of blood in the urine show absorption-lines between Frauenhofer's lines D and E in the yellow and green of the spectrum. *See* SPECTROSCOPE.

The blood in hæmaturia may be derived from the urethra. If so, it precedes the stream of urine, sometimes forms a long thin clot, and may escape in the intervals of micturition. Sometimes it is derived from the prostate gland or the bladder. When it has lain in the bladder and been poured out in considerable quantity, it is often in clots; and when the urine is voided, the first part is frequently clear, the last loaded with blood. Blood may also be derived from the ureter or the pelvis of the kidney. Sometimes clots in the form of moulds of these structures may be recognised. At other times the blood is derived from the substance of the kidney, and then is intimately mixed up with the urine, which frequently exhibits bloody tube-casts.

ÆTIOLOGY AND PATHOLOGY.—Urethral hæmorrhage is due to local inflammation or rupture of vessels. Prostatic hæmorrhage may be due to malignant disease, to tumours, to inflammation, or to scrofulous affection of that organ. Vesical hæmorrhage results from malignant disease, from simple villous growth, inflammation, ulceration, tubercular disease, or the irritation of calculus. Hæmorrhage from the ureters or pelvis of the kidney may be due to the presence of calculi, or to unexplained causes. Hæmorrhage from the kidney may be due to cancer, tubercle, suppurative nephritis, or to the irritation of crystals or amorphous concretions within the uriniferous tubules. Hæmorrhage occurs also in all the forms of Bright's disease, especially in the early stage of the inflammatory form, and the advanced stage of the cirrhotic. It results moreover from over-doses of turpentine and cantharides, and from rupture of the kidney. Sometimes it is a manifestation of purpura hæmorrhagica, more rarely of scorbutus; and occasionally it occurs in the course of, or as a sequel of eruptive or continued fevers. It is also occasionally vicarious. Renal hæmorrhage occurs in Egypt, Mauritius, and other localities,

in consequence of the presence in the pelvis of the kidney of a minute parasite, the Bilharzia hæmatobia; or of the presence in the blood of the Filaria sanguinis-hominis. *See* Bilharzia; Chyluria; and Filaria Sanguinis-Hominis.

Treatment.—The treatment of hæmaturia must vary according to the lesion to which the hæmorrhage is due, but where the symptom is so urgent as to demand treatment for itself, the most important points to be attended to are rest; free relief of the bowels; the application of ice-bags over the source of the hæmorrhage; along with the internal administration of astringents, especially gallic acid, ergot of rye, perchloride or pernitrate of iron, turpentine, or acetate of lead, with or without opium. If these do not succeed, the subcutaneous injection of ergotine is often efficacious. Surgical interference may be required for relief of symptoms due to coagula. T. Grainger Stewart.

HÆMIC ASTHMA.—A form of asthma, dependent upon an abnormal condition of the blood. *See* Asthma.

HÆMIC MURMUR.—A murmur connected with the condition of the blood, as in anæmia. *See* Anæmia; and Physical Examination.

HÆMIN.—*See* Hæmoglobin.

HÆMOGLOBIN (*αἷμα*, blood, and *globus*, a ball). Synon.:—Hæmatoglobulin; Hæmatocrystallin; Cruorin (Stokes).—This substance, which is of great physiological interest, is of an extremely complex nature, being a compound of two bodies, the one a proteid known as globulin or globin; and the other a nitrogenous derivative called hæmatin. These two substances are combined in the proportion of 87·5 per cent. of globulin to 12·41 per cent. of hæmatin (Schmidt); and the provisional formula of hæmoglobin, according to Hoppe-Seyler, is $C^{600}\ H^{960}\ N^{154}\ Fe\ S^3\ O^{179}$. If we estimate the red corpuscles as forming about 32 per cent. of ordinary blood, hæmoglobin may be considered as forming 13 to 14 per cent. of the same blood.

Hæmoglobin presents a singular exception to the general law of diffusion, inasmuch as, though it readily crystallises, it will not diffuse through membrane as such without decomposition. A considerable variety in the shape of the crystals is met with in different animals; in man they occur as elongated prisms.

The most important property of this compound is its affinity for oxygen. In some obscure manner this gas enters into a loose combination with hæmoglobin, forming *oxy-hæmoglobin*; and is then conveyed by the red corpuscles throughout the body; separating again from its conveyer in the tissues. The hæmoglobin thus deprived of its oxygen is known as *reduced hæmoglobin*, and is of a purplish colour, whilst the oxy-hæmoglobin is of a scarlet tint. It is thus that the difference in colour between arterial and venous blood is mainly to be accounted for. It is to be noted that whatever be the nature of the combination that exists between the oxygen and its carrier, it is such that the gas retains its properties as a gas, and the union may be roughly compared to a mere solution of the gas in a fluid. The recent experiments of Malassez, Hayem, Gowers, and others have furnished us with means of estimating within very reasonable limits the quantity of red corpuscles contained in any sample of blood (*see* Hæmacytometer); and further by a comparison of its colour with that of a solution of known strength the percentage of hæmoglobin in it may be ascertained with tolerable accuracy (*see* Hæmoglobinometer). We are as yet unacquainted with the variation in its amount in the majority of diseases, but a very considerable diminution, even to the extent of 25 per cent., has been met with in chlorosis. Whether with the alteration in quantity of hæmoglobin there is any change in its composition is uncertain; from the improvement following the administration of iron in certain cases of anæmia it would seem that there may be. As regards the iron-constituent of this compound, amounting to ·4 or ·5 per cent., it has been suggested, although on no very good grounds, that the oxygen-carrying property is due to this element. It is noticeable that in some of the lower animals copper has been met with, taking the place of iron.

From a pathological point of view, hæmoglobin is chiefly of interest in respect to its derivatives, which are easily obtained by the action of heat, acids, alkalies, &c., and also on account of the relationship that exists between this substance and the various pigments met with in the body. The chief derivatives of hæmoglobin, namely, hæmatin, hæmatoidin, and hæmin, will now be described.

Hæmatin.—$C^{68}\ H^{70}\ N^8\ Fe^2\ O^{10}$ (Hoppe-Seyler). Hæmatin may be obtained from red blood corpuscles by treatment with alcohol, acidulated with sulphuric acid.

Hæmatin is an amorphous dark-brown powder. A solution gives a characteristic absorption-band in the spectrum, different from those produced by hæmoglobin. It gives a green solution when boiled with caustic potash.

Hæmatoidin (*αἷμα*, blood, and *εἶδος*, appearance). ($C^{17}\ H^{18}\ N^2\ O^3$).—Hæmatoidin may be prepared from hæmatin by the action of acids, which remove the iron. This substance is crystalline (rhombic prisms or needles), and of a red or greenish-red colour; a fact which shows that the colour of hæmoglobin is not dependent on the iron. It is of considerable pathological interest, being frequently found in old clots, and in the cavity of ruptured Graafian follicles; it is the cause also of the staining so often seen in the neighbourhood of extravasations of blood, varying from lemon-yellow up to reddish black.

Hæmin ($C^{68}\ H^{70}\ N^8\ Fe^2\ O^{10}\ 2\ HCl$).—Hæmin, which may be prepared from dried hæmoglobin by treatment with glacial acetic acid, in the presence of an alkaline chloride, is a hydrochlorate of hæmatin. It crystallises tolerably readily in needles or rhombic plates, and thus becomes an easy means of detecting the presence of blood in stains of a doubtful nature.

The relationship of hæmoglobin, hæmatin, hæmatoidin, and hæmin to the pigments of the body is of the greatest interest. It would seem that the hæmoglobin is the source of all—biliary, urinary, &c. Bilirubin is closely allied to, if not identical with, hæmatoidin; and a play of colours—the result of oxidation—may be obtained from the latter when treated with nitric acid, similar to that produced by the bile-pig-

ments under the same condition. The injection of hæmoglobin into the blood is followed by the presence of bile-pigments in the urine, and an increase of bilirubin in the bile. Melanin, the black pigment often found in connection with new-growths, especially with those of a malignant character, also appears to be directly drawn from hæmoglobin. The colouring matter of the blood is obviously associated, in some way other than that of its oxygen-carrying function, with the nutrition of the tissues, in connection with the obscure but unquestionable influence of pigments. W. H. Allchin.

HÆMOGLOBINOMETER (Hæmoglobin; and *μέτρον*, a measure).—Definition.—An instrument for the clinical estimation of the amount of hæmoglobin in blood.

Description.—The promotion of hæmoglobin may be ascertained by estimating the amount of iron in the blood, or the amount of dilution necessary to obscure a certain absorption-band in the spectrum (*see* Spectroscope). Neither of these methods is, however, available for clinical use. Simpler methods have therefore been contrived, which proceed by comparing the colour of diluted blood with that of solutions of carmine and picrocarmine. By this combination the tint of blood and even its spectrum may nearly be obtained (Malassez). Coloured discs have been employed for the same purpose (Hayem). In these methods a given dilution of blood is made, and this is compared with the tint of the standards. In the hæmoglobinometer designed by the writer (and made by Hawksley) the blood is progressively diluted until it reaches the tint of a standard the colour of which corresponds to a dilution of 1 part of healthy blood in 100 of water. The degree of dilution necessary to make the two correspond represents the amount of hæmoglobin. The apparatus consists of two tubes of exactly equal diameter, and a capillary pipette, holding 20 cubic mm., for measuring the blood. One tube is filled with a standard, consisting of glycerine jelly coloured to the required tint. The other is graduated, each division being equal to the volume of blood taken (20 cubic mm.), so that 100 divisions equal 100 times the volume of blood. The dilution is made by a pipette stopper, and the number of degrees of dilution necessary indicates the percentage proportion of the hæmoglobin of the blood examined to normal blood. For example, the blood of a patient being progressively diluted, is found to reach the tint of the standard when the amount of water added corresponds to 45 degrees of dilution; the blood examined therefore contains 45 per cent. of the normal quantity of hæmoglobin. W. R. Gowers.

HÆMOPERICARDIUM. *See* Hæmatopericardium.

HÆMOPHILIA (*αἷμα*, blood, and *φιλία*, predisposition for).—Synon.: Hæmorrhaphilia; Hæmorrhagic diathesis; Bleeders; Fr. *Hémophilie*; Ger. *Bluterkrankheit*.

Definition.—A congenital disease, often hereditary, characterised by a tendency to immoderate bleedings, whether spontaneous or traumatic, and to obstinate swellings of the joints.

Ætiology.—Men are far more liable than women to this disease; the proportion being about eleven to one. Women who suffer from hæmophilia show much less typical specimens of the disease than men, and rarely die from hæmorrhage, although floodings and profuse menstruation are common.

The best-ascertained cause of hæmophilia is hereditary predisposition. No other cause is known with anything like certainty. In a bleeder family, the disease descends to the boys through the mothers, the women remaining quite healthy and apparently free from all disease. The fathers do not seem to transmit the disease to their sons; at least, instances of this are rare. The women of bleeder families are remarkably fertile. Some have thought this disease to be more common in Germany, but this is probably owing to the greater attention paid to the disease in that country. Cases have been met with in the Indian Archipelago, North America, the Scandinavian kingdoms, and elsewhere. The disease is not limited to the Aryan races, as the Jews, a Semitic nation, are singularly liable to it.

Anatomical Characters.—No morbid appearances have yet been found after death with any constancy. The blood-vessels examined with the microscope have shown no change. The blood is apparently unaltered. Yet it is most probably the vessels which are at fault; as in most of the other hæmorrhagic diseases about which much is known, the vessels have been found diseased. The swellings of the joints appear to be due to the extravasation of blood within the articulation.

Symptoms.—The first signs of hæmophilia are commonly seen during the first year of life; but sometimes they are delayed until the beginning of the second dentition. Cases on record of a much later appearance of the first symptoms are not trustworthy. It is very rare for bleedings to be noticed at birth. There is nothing about the subjects of hæmophilia, when not suffering from bleeding, to distinguish them from ordinary persons. They look well; and nothing amiss can be discovered by physical examination in chest or belly. It is stated, also, that the boys have often good ability and do well at school.

There are three well-marked *degrees* of hæmophilia. The first is the most typical and characteristic, in which there is a tendency to every kind of hæmorrhage, traumatic or spontaneous, interstitial or superficial. The swelling of the joints is well-marked. This degree is scarcely ever seen in women; but it is the most common among men. In the second degree, spontaneous hæmorrhages from the mucous membranes only are present. The third degree, in which the tendency is little marked, is seen only amongst the women of bleeder families; and shows itself only by spontaneous ecchymoses.

Hæmorrhage. — Spontaneous bleedings are sometimes preceded by prodroma. These are symptoms of unusual fulness and plethora. The mucous membranes supply the blood in this case; in childhood bleeding from the nose being the most common, and also the most fatal, although bleedings from the bowel, mouth, or chest may also occur. There is only one known instance of death from hæmaturia. The traumatic bleedings vary much in intensity, even in the same individual. Death has followed division of

the frænum of the tongue, vaccination, leeching, and the extraction of a tooth. This last is a very common cause of death, and ought never to be undertaken in hæmophilia. If abscesses be opened, furious bleeding commonly takes place; and the same occurs if a blood-tumour or extravasation of blood be interfered with.

The bleeding is nearly always capillary, and may kill in a few hours or after some weeks. The quantity of blood lost is sometimes enormous. After the bleeding the patients are extremely anæmic; and this state may last for months.

Besides superficial bleedings, interstitial hæmorrhages, ecchymoses, and blood-tumours may be observed, whether spontaneous or traumatic. A bruise which a healthy person would not feel may fill the connective tissue of a limb with blood; or the bleeding may be circumscribed, and form a tumour instead.

Swelling of the joints.—This chiefly affects the larger joints, the knee being most commonly attacked. The joint, most commonly after some injury, becomes swollen and painful, and apparently filled with fluid; there is fever; and this state may last for many weeks, and is very apt to relapse during convalescence.

Diagnosis.—The diagnosis of hæmophilia is often easy. If a boy have suffered repeatedly from early infancy from abundant bleedings—especially traumatic—and from joint-affections, there can be no doubt of the diagnosis. It is made more certain by the existence of hereditary predisposition. In women the diagnosis must be made with more care, as they are subject to a hæmorrhagic disorder which first appears about puberty, but which is not hereditary.

Prognosis.—The prognosis is bad as regards complete recovery, though not so serious with respect to life as was formerly thought.

Treatment.—In the treatment of the bleedings of hæmophilia, styptics are of little use. The spontaneous form should not at first be interfered with; but the traumatic may often be stayed at its first onset by the judicious use of compression. The tincture of perchloride of iron seems the best internal remedy. In the last resort, transfusion may be had recourse to. In the intervals of hæmorrhages, meat diet, cod-liver oil and steel, and residence in a warm climate, are the most appropriate remedies. All surgical or medical procedures by which blood is drawn must be strictly avoided. There are, however, only two instances on record of disagreeable consequences following vaccination. Marriage should be forbidden, especially to women who do not themselves suffer from the disease, but belong to bleeder families.

The joint-affection must be treated chiefly by rest and the application of splints.

J. Wickham Legg.

HÆMOPTYSIS (αἷμα, blood, and πτύω, I spit).—Synon.: Pneumonorrhagia; Bronchorrhagia; Fr. *Hémoptysie*; Ger. *Bluthusten*.

Definition.—Blood-spitting having its source in pulmonary or bronchial hæmorrhage.

The restriction of the term hæmoptysis, as thus defined, has the sanction of long usage and convenience. Hæmorrhage from an aneurism opening through the lung or air-passages would not strictly be included in such a definition.

Spitting of blood when it arises from other and less important sources comes under the denomination of *false* or *spurious* hæmoptysis.

Ætiology and Pathology.—The causes of hæmoptysis in the widest sense of the term, and having regard to its pathology, may be thus enumerated:—

I. Hæmorrhage from the pulmonary artery or its radicles.

1. Rupture or wound of the lung from external violence.

2. Active hyperæmia of the lungs—inflammatory, vicarious, or induced by violent effort or excitement. The active hyperæmia may be primary as regards the lungs; or may supervene or be attendant upon disease already present in them.

3. Mechanical hyperæmia of the lungs, secondary to heart-disease, or embolism of one of the pulmonary branches, or to pressure from tumours, such as enlarged bronchial glands (*see* Bronchial Glands, Diseases of).

4. Necrotic division of vessels in the course of softening of tubercular or other consolidations in destructive lung-diseases—phthisis, tuberculosis, cancer.

5. Aneurismal dilatation or simple erosion of branches of the pulmonary artery, exposed in the course of excavation of the lung, or ulceration of the bronchial mucous membrane.

6. Primary atheroma of the pulmonary artery within the lung.

II. Hæmorrhage from the bronchial capillaries.

Capillary hæmorrhage from the bronchial mucous membrane.

III. Hæmorrhage from the aorta, or one of its great branches.

Aneurism rupturing through the lung or into a bronchus.

Details respecting the pathology of these several forms of hæmoptysis will be found under the headings of the principal diseases giving rise to them. There are a few additional remarks, however, that should be introduced here.

The pathology of hæmoptysis occurring in early phthisis—of which it is one of the most frequent symptoms—is still somewhat obscure. Besides the active hyperæmia above referred to, that is, the inflammatory congestion that constitutes the first stage of some kinds of phthisis, and tends to recur at different periods of the disease; besides also the necrotic division of vessels, or their aneurismal dilatation, which more especially account for the hæmorrhage occurring in the later stages of the disease; there are other conditions present in early phthisis which probably have much to do with the occurrence of hæmoptysis. The minute blood-vessels are importantly concerned in the very earliest stage of phthisical lung-disease in one or other of three ways:—

(*a*) Their walls become the seat of nuclear proliferation, and hence become softened; and (*b*) these vessels become more or less extensively blocked, not merely as the result of the inflammatory *stasis* which may affect their capillaries, but by the pressure of surrounding tubercular

growth. (*c*) It is very possible that in the ill-developed lungs of small-chested people, who inherit a tendency to consumption, the vessels are also morbidly frail, and are apt to give way in any temporary hyperæmia. Some persons are remarkably subject to irregular distribution of blood; they are liable to chills, cold extremities, and transient flushings; and a *pulmonary blush* is as conceivable as a temporary flush elsewhere, and would favour the occurrence of hæmorrhage.

It has been alleged that the hæmoptysis occurring in all stages of phthisis frequently has its source in hæmorrhage from the bronchial tubes, and that this bronchial hæmorrhage may give rise secondarily to phthisis, or may, when it occurs in the course of that disease, set up fresh centres of mischief in the lungs by inhalation of blood to distant portions. In the entire absence of reliable pathological grounds for this view, and in the abundance of anatomical evidence, clinical experience, and weight of authority in favour of the pulmonary origin of hæmoptysis, we are, in the opinion of the writer, justified in believing that decided hæmoptysis originating in hæmorrhage from the bronchial mucous membrane is exceedingly rare, excluding, perhaps, syphilitic ulceration of the bronchi. Blood inhaled to distant portions of lung may, however, as shown by Dr. Reginald Thompson, undergo changes resulting in fresh pulmonary destruction.

Description.—The quantity of blood brought up in hæmoptysis varies from a mere streak to two or three quarts. When blood is expectorated in large quantity, it is pure and unmixed; and either dark and venous, or bright arterial. The first and last portions are usually more or less aërated. If in small quantity, the blood is most generally bright and frothy, it may be only a speck or two upon the sputum, or it may be in several mouthfuls of pure aërated blood. It commonly happens that this mitigated and more characteristic hæmoptysis precedes the rarer attack of profuse hæmorrhage that may prove instantly fatal. Hæmoptysis is sometimes scanty, dark, and clotted, usually from a small portion of blood having been detained in the lung before being expectorated.

In decided hæmoptysis the shock to the system is always great. The patient is alarmed and anxious, especially on the first attack. The sense of weakness and prostration is, indeed, often prolonged after the attack—not necessarily a severe one as regards quantity of blood lost—has ceased. The face is often flushed, the extremities cold. The temperature is usually depressed; after a few hours it becomes normal, and it may continue so, or it may rise in the course of forty-eight hours or within five days. This elevation of temperature may depend (*a*) upon return of the previous fever after being temporarily checked by hæmorrhage; (*b*) upon the cause which has also produced the hæmoptysis; or (*c*) upon the secondary consequences of the hæmorrhage. It has been clearly shown that the inhalation of blood into the bronchial tubes and pulmonary alveoli sometimes sets up broncho-pneumonia, and thus may give rise to fresh centres of phthisical disease. The later the rise of temperature up to the fifth day, the more reason we have for regarding it as due to secondary pneumonia.

Anatomical Characters. — These depend very much upon the nature of the disease which has preceded the hæmoptysis. In cases of death from hæmoptysis there are the usual appearances —pallor of organs, empty and contracted ventricles, &c.—of death from hæmorrhage. The bronchial tubes of both lungs are found to contain clots. The healthy portions of lung are found inflated from obstructions in the bronchi, impeding the exit of air; they are generally pale, but beautifully speckled by pink spots, marking the lobules into the air-cells of which blood has been inhaled. If death take place several days after profuse hæmoptysis, any blood which remains in the bronchi is dark and disorganised, and patches of consolidation may sometimes be found, having for their centres the stained appearance attributable to inhaled blood. More or less bronchitis is also noticeable. It is rare to find fatal hæmoptysis without the presence of cavities, which are also, more or less, filled with blood-clot. In almost every instance of fatal hæmoptysis in phthisis, sufficient diligence will discover either an aneurism of a pulmonary vessel within a cavity, or ulcerative erosion of an exposed vessel. The writer has found such a condition in fifteen cases at various ages, including one infant seven months old.

Significance of Hæmoptysis.—No modification in our views respecting the nature of phthisis can lessen the significance of hæmoptysis as being one of its most important positive signs. Thus regarded, it is a warning that may sometimes save, and very often prolong life, by drawing our early attention to a condition that might otherwise remain too long concealed; but, lightly considered and carelessly treated, it is but the precursor of destructive disease.

Diagnosis.—Genuine hæmoptysis can rarely be mistaken by a skilled observer present at the attack. The gurgling in the bronchi, the loose cough, and repeated expectoration of *bright frothy* blood are quite characteristic. The blood is distinctly expectorated with cough, not vomited; and its quality is distinctly fresh, not changed. In hæmatemesis, with which hæmoptysis is sometimes confounded, the blood is brought up by vomiting; is more or less mixed with the contents of the stomach; and, save when the hæmorrhage is very rapid and abundant, presents a dark grumous appearance, owing to the action of the gastric fluid upon it (*see* Hæmatemesis). It may, too, be observed that the blood does not come from the nose, unless a small quantity be projected through the nostrils with the spasmodic cough. If, as often happens, no medical attendant is at hand at the moment of the attack, the appearance of the blood is usually sufficient for diagnosis; and if the hæmoptysis have been at all copious, any further expectorations for the next few hours are sanguineous. The fact of this sanguineous colouration of the sputa having existed for some hours, or a day or two after an hæmoptysis, is positive evidence of the hæmoptysis having been genuine. In cases of *very copious* hæmorrhage from a large pulmonary branch, the blood brought up is dark and venous.

It is very important in investigating the cause of hæmoptysis to be as gentle as possible in physical examination. We can listen to the

lungs in front and to the heart without moving the patient or requiring him to breathe deeply; we can make a note of the temperature; and at the time we should do no more.

The throat should always be examined in doubtful cases of hæmoptysis, as the blood will sometimes be found to have issued from an ulcerated tonsil, or even from enlarged vessels on the posterior wall of the pharynx. *Spurious hæmoptysis*, however, may be defined as *the escape of a blood-stained mucus from the throat or gums.* In cases of spurious hæmoptysis there is usually distinct evidence of a morbid condition of these parts. The mucous membrane of the fauces is relaxed; the gums are spongy, and often bleed when the teeth are brushed in the morning. Sometimes this condition of gums arises from insufficient attention to the teeth; carious stumps and much tartar round the teeth causing irritation and sponginess of the gums. The patients are usually anæmic and short-breathed, and often complain of morning cough, but there is no evidence of lung-disease. The blood-stained mucus is usually ejected in the morning, on waking, and often escapes from the mouth during the night, staining the pillow. On examination, it is found to be a pink, watery mucus, uniformly stained, and containing comparatively few blood-corpuscles.

Treatment.—Absolute rest is the first thing to be observed in the treatment of all attacks of hæmoptysis. The patient should lie down with the head and shoulders raised by pillows. He should not talk. The room should be kept quiet and cool; the bed-clothes should be light, but sufficient; and warmth should be applied to the feet. A little ice in the mouth, or some iced water to sip, will ease the cough and tend to check hæmorrhage. The patient must, if possible, be reassured as to the absence of present danger, and the shock to the system allayed without the use of stimulants. Sometimes opium may be usefully given for this purpose, due regard being had to the habits and idiosyncrasies of the patient. Astringent medicines are not always needed in hæmoptysis, especially in attacks in which the hæmorrhage is presumably capillary; they may, however, be given in such cases in small doses. To be really useful in hæmoptysis, astringents must be given in full doses. Those most used are acetate of lead, four grains, every three or four hours; alum, twenty grains, with dilute sulphuric acid, thirty minims, every four hours; gallic acid, twenty to thirty grains every half-hour or hour, for two or three doses, followed by ten-grain doses every three hours; oil of turpentine, thirty minims every two hours in sweetened mucilage or in milk, for a couple of doses, then in half or third doses; liquid extract of ergot in half-drachm or drachm doses, every two or three hours; ten- or fifteen-minim doses of the pernitrate or persulphate of iron solution, or thirty or forty minims of the perchloride freely diluted. Of the above-mentioned astringent remedies, alum and sulphuric acid, gallic acid, and ergot are the best in the greater number of cases. Acetate of lead is less applicable to cases of lung-hæmorrhage than in bowel or kidney lesions. Ergot is to be preferred in those cases in which we infer that a considerable vessel has given way. It may also be given in the form of ergotin—½ to 2 grains hypodermically; but thus given it sometimes causes much local inflammation. Oil of turpentine is certainly one of the most powerful of astringents in pulmonary hæmorrhage, and may be usefully held in reserve. When freely administered the condition of the urine must be carefully noted. Cases of hæmoptysis only rarely occur in which it is well to give the iron astringents. As a rule they tend to increase pulmonary congestion; but in some cases, in which hæmoptysis has a tendency to continue after the patient has been brought to a state of profound anæmia from the first outburst, they may be usefully given, their effect being carefully watched. Digitalis is a drug sometimes of great value in hæmoptysis; it is best adapted to those cases in which there is much excitement of circulation. In cases, for instance, in which the hæmoptysis has been determined by intemperance, or in full-blooded people by effort, tincture of digitalis in twenty- or thirty-minim doses may be given. In such cases, in which the portal system is usually congested, sulphate of magnesia and dilute sulphuric acid may be combined with the digitalis, and given every four or six hours for a couple of days or so. In the treatment of hæmoptysis it is usually necessary to counteract the effect of the astringent upon the bowels by purgatives or laxatives. An enema may be necessary to enable the bowels to act easily and without straining. The use of the bed-pan must of course be enjoined.

Counter-irritation is of great value in the treatment of many cases of hæmoptysis, chiefly in those cases in which the hæmorrhage is not great, and occurs in the course of phthisis, being due either to local pulmonary congestion, or to active hyperæmia of the walls of a cavity. Blisters are, as a rule, best avoided in copious hæmoptysis during the stage of shock. Continuous cold to the chest is decidedly to be deprecated. The intermittent application of cold may sometimes be employed, but is a measure of doubtful expediency.

The temperature and pulse of the patient should be carefully watched during an attack of hæmoptysis, and for a few days afterwards.

The diet must at first be restricted to cold nutritious fluids; stimulants, except in special cases, must be interdicted.

The treatment of *false* or *spurious hæmoptysis* depends upon its cause. In most cases the cause being anæmia, with a relaxed and morbid condition of mucous membranes, an acid preparation of iron containing some chlorate of potash and glycerine will speedily cure the malady. When the gums are spongy, the addition of finely powdered kino or catechu to a chalk or charcoal tooth-powder, or the addition of some glycerine of tannin to the tooth-water will prove efficacious. Astringent gargles will suggest themselves in fitting cases; and fruit and vegetables must be added to the diet. R. Douglas Powell.

HÆMORRHAGE (αἷμα, blood, and ῥήγνυμι, I burst forth).—Synon.: Fr. *Hémorrhagie*; Ger. *Blutfluss.*

Definition.—The escape of blood from any part of the circulation, and its discharge from the body.

When blood escapes from any of its natural

reservoirs, it is either extravasated into the neighbouring organs or cavities, or flows from one of the surfaces or orifices of the body. In the latter case only is the term 'hæmorrhage' strictly applicable (*see* EXTRAVASATION). This distinction, however, is not always carefully observed; and such expressions as 'cerebral hæmorrhage,' 'hæmorrhage into the pericardium,' and 'hæmorrhagic eruptions' are applied in connection with what are more correctly called *extravasations* of blood.

ÆTIOLOGY.—Hæmorrhage is almost always due to a solution of continuity of some part of the circulatory system, whether by injury or by disease. Hæmorrhage from the external surface of the body is, with few exceptions, the result of wounds or other form of injury; but ulceration—either simple or malignant—frequently lays open a vein or an artery, and aneurism of the great vessels, and even of the heart, may also give rise to external bleeding. Hæmorrhage from internal organs, on the contrary, is most frequently the result of disease, as, for instance, ulceration or aneurism, or of circulatory disturbance, such as congestion. Great excitement or severe exertion is one of the chief determining causes of hæmorrhage, by producing great or sudden rise of the general blood-pressure, whether by cardiac disturbance or by obstruction of the terminal vessels, and may even lead to the rupture of healthy vessels. Local disturbances of the blood-pressure give rise in the same way to congestion or hyperæmia, and finally to hæmorrhage. The principal causes of hæmorrhages of this class are diseases of the heart, of the great vessels, of the respiratory organs, and of the liver, and sudden variations in the atmospheric pressure or in the temperature; and such hæmorrhages are also in some instances undoubtedly of a *vicarious* nature. Certain conditions of the blood are believed to predispose to hæmorrhage, as, for example, in scurvy, purpura, the malignant fevers, chronic Bright's disease, and alcoholism. There is, probably, however, a lesion of the vessel-walls in some of these diseases. A peculiar condition of body is known as the *hæmorrhagic diathesis* or hæmophilia; the subjects of which exhibit, amongst other forms of debility, a remarkable tendency to profuse hæmorrhage from trivial causes. *See* HÆMOPHILIA.

SEATS AND VARIETIES.—Bleeding from the surface of the body, whatever its origin, is simply called *hæmorrhage*, and its exact source and situation are otherwise defined. On the other hand, when blood escapes by any of the natural openings of the body, and is derived from an internal organ, the hæmorrhage is described by a special name. Hæmorrhage from the nose is called *epistaxis*; from the ear *otorrhagia*; from the stomach *hæmatemesis*; from the respiratory tract *hæmoptysis*; and from the urinary tract *hæmaturia*. Blood passed *per anum*, after undergoing certain changes to be referred to immediately, is called *melæna*. *Menorrhagia* and *metrorrhagia* are the names given to profuse bleeding from the genital organs in the female, at the menstrual period and at other times, respectively.

DESCRIPTION.—The local phenomena that characterise hæmorrhage from the external parts of the body, vary with the source of the blood. If it proceed from an artery of considerable size, it escapes in the form of a jet, which is strengthened at each beat of the pulse as an active spurt. Blood discharged from an opened vein either flows in an abundant continuous stream, or wells up from the depth of the tissues in which the vessel lies. Capillary hæmorrhage is generally much less profuse, and is most frequently seen in the form of oozing. Blood proceeding from internal organs is variously discharged by the several outlets. Sometimes it is immediately expelled, especially if in quantity; or it may escape even when in small quantity, owing to gravitation, as in hæmorrhage from the nose. Most frequently the blood is retained for a time, and then, acting as a foreign body, is ejected; for example, in bleeding from the stomach, bowels, or bladder.

Characters.—Blood flowing from the surface of the body usually presents its familiar characters. The colour of the blood will be scarlet when it is derived from an artery; purple, with a tendency to become scarlet on the surface, when it flows from a vein; and of a tint intermediate between these two colours when the hæmorrhage is capillary. In all cases, the blood coagulates more or less abundantly around the seat of hæmorrhage.

In hæmorrhage from internal organs, on the contrary, the blood is frequently coagulated; more or less mixed with the fluids of the part; or otherwise altered during its transit. The following are the principal changes that blood undergoes in its passage towards the several outlets of the body:—

Blood flowing from the *external ear*, or from the *anterior nares*, is frequently thin and watery, if the hæmorrhage have lasted for any length of time. Blood discharged from the *posterior nares* is often coagulated, black, and mixed with thick mucus. In hæmorrhage from the *mouth*, the blood may be derived from that cavity; from the fauces; from the respiratory passages; or from the upper portion of the digestive tract—especially the stomach. When the blood flows from some part of the *mouth*, such as the gums, tongue, palate, or cheeks, it is more or less intimately mixed with frothy saliva and mucus. In hæmorrhage from the *respiratory passages*, or from the *stomach* through the mouth, the ejected blood varies extremely in different instances. Hæmorrhage from the genito-urinary tract is also specially described. Hæmorrhage from the bowels is not peculiar, if the source of the blood be near the anus, or if the bleeding be very profuse; taking the form sometimes of a gush of fresh, warm blood, at other times of a mere red streak upon the fæces. If the blood be derived from a higher part of the intestines, the appearace of it, when discharged, will be different. Generally it is so far altered by the action of the various intestinal contents, as to be converted into a black tarry-looking mass (*see* MELÆNA). Less frequently, the bleeding may be so profuse as to fill a considerable portion of the bowel, and clots of blood may then be passed, as in some cases of hæmorrhage in typhoid fever. The peculiar characters of *menstrual* blood are described elsewhere. Hæmorrhage from the *uterus* in large quantity consists of unaltered blood, whether coagulated or not.

Course and Terminations.—Hæmorrhages caused by wounds are generally most profuse at first; and, unless they prove fatal speedily, or are artificially arrested, gradually cease. On the contrary, hæmorrhages due to disease are frequently insignificant at first, and increase in amount; or they recur again and again in variable quantity.

Many natural causes contribute to the arrest of hæmorrhage, the most important being—weakening of the force of the heart by the loss of blood; the contraction of the coats of the vessels at the seat of lesion; the coagulation of the blood—first around, and then within the open vessel; the pressure of the extravasated blood in the surrounding tissues; and the increased coagulability of the blood after the flow has continued for some time. The relief of the local disturbance of pressure by the occurrence of the hæmorrhage, is alone sufficient in many instances to arrest the flow.

Effects.—The effects of hæmorrhage are chiefly exerted upon the system generally; and they are therefore remarkably uniform, whatever may be its locality. The circumstances that more especially affect the intensity of the effects or symptoms are two, namely, the amount of blood lost, and the rapidity of the flow. When hæmorrhage is at once free and persistent, syncope rapidly ensues, probably accompanied by convulsions, and ending speedily in death unless the bleeding either spontaneously cease, or be artificially arrested. The sudden loss of one half of the total amount of blood in the body (say five pounds) is said to be sufficient to cause death. On the other hand, enormous quantities of blood may be lost without a fatal result if the hæmorrhage be slow, or frequently repeated with considerable intermissions. The condition of the subject of the hæmorrhage then becomes one of anæmia (*see* Anæmia). More moderate bleedings frequently repeated produce faintness, and may cause a certain degree of pallor, which shortly disappears. Moderate hæmorrhages from certain situations, for example from the nose, rectum, or even the lungs, may sometimes relieve congestion, and be attended with great relief and benefit.

Local effects do, however, occur in some forms of hæmorrhage. Hæmoptysis may be accompanied by inhalation of blood, and lead to inflammation or more complex disease of the lungs. Hæmorrhage into the uriniferous tubules causes plugging of these, and discharge of blood-casts. Blood retained in the generative or in the respiratory passages occasionally becomes decomposed. The special symptoms of the several forms of hæmorrhage are described under the head of each.

Treatment.—The treatment of hæmorrhage from external parts is a subject of purely surgical interest; but it may be said that, in cases of emergency, moderate pressure with the finger or other means, on the seat of the bleeding, is generally practicable and successful. Hæmorrhage from internal parts requires special treatment according to the particular organ from which it is proceeding. The reader is, therefore, referred to the several articles on Epistaxis, Hæmatemesis, Hæmaturia, Hæmoptysis, Melæna, and Menstruation, Disorders of; as well as to the articles on Hæmostatics, and Styptics.

J. Mitchell Bruce.

HÆMORRHAGIC (αἷμα, blood, and ῥήγνυμι, I burst forth).—Associated with hæmorrhage. The word is applied to certain inflammatory products or to effusions when they contain blood, as in *hæmorrhagic peritonitis*; and to varieties of certain diseases in which extravasations or hæmorrhages from free surfaces occur, for example, *hæmorrhagic small-pox*, *hæmorrhagic measles*, and *hæmorrhagic purpura*.

HÆMORRHAGIC DIATHESIS. *See* Hæmophilia.

HÆMORRHOIDS (αἷμα, blood, and ῥέω, I flow).—Synon.: Piles; Fr. *Hémorrhoïdes*; Ger. *Hæmorrhoiden*.

Description.—The hæmorrhoidal veins distributed to the lower part of the rectum are very liable to become dilated and varicose, giving rise to a disease termed *hæmorrhoids* or *piles*. When the plexus beneath the mucous membrane within the external sphincter is thus affected, the hæmorrhoids are said to be *internal*. When the veins beneath the integuments outside the muscle are enlarged, the hæmorrhoids are called *external*. Internal and external hæmorrhoids very frequently co-exist.

External Hæmorrhoids.—We may distinguish two kinds of external piles:—(1) A *sanguineous tumour*. (2) A *cutaneous excrescence* or outgrowth.

(1) The *sanguineous tumour* consists of a softish elevation of the skin near the margin of the anus, of a rounded form, and a livid or slightly blue tinge. On cutting into it, we find a dark-coloured coagulum enclosed in a cyst.

(2) The *cutaneous excrescence*, or second form of external piles, consists of a flattened prolongation of skin, due to hypertrophy of the epidermis, papillæ, and cutaneous layers. It is generally the result of the first form, a projecting fold left after absorption of the coagulum having undergone further growth. Often there is only a single broad flat excrescence at the side of the anus; but sometimes there are two, one on each side; and occasionally there are several encircling the anus. Similar excrescences occur as the result of irritating discharges from the bowel, and are common in stricture and chronic ulceration of the rectum.

Internal Hæmorrhoids. — Internal piles seldom attract attention until they have become so developed as to protrude at the anus in defæcation. They then exhibit a remarkable diversity of appearance, according to their number, size, and condition. The protrusion may consist of only one large pile, found usually towards the perineum, especially in women. More commonly there are three distinct prominent growths, differing in size, one at each side of the anus, and a third in front—the latter, the perineal, being the largest. In old cases they may be more numerous—as many as four or five. The distinction between them is commonly well-marked, but not always, for the piles sometimes merge into each other, so that the protrusion forms nearly a

circular prominence. The aspect of extruded piles depends much upon their condition, whether congested, inflamed, or constricted by the sphincter. In an inactive state, and in a relaxed condition of the sphincter, they form softish tumours of a granular appearance, presenting just at the orifice of the anus; but when protruded and congested, they constitute large tense tumid swellings, of a deep red colour and smooth surface, which readily bleed. When hæmorrhoids are of large size, the integuments at the margin of the anus become everted, and form a broad band girting the base of the tumours. The skin thus everted is liable to be mistaken for external piles, and to be excised in operations—an error very likely to be followed by serious contraction of the anus.

Ætiology.—Hæmorrhoids are a disease of middle and advanced age. They rarely occur before puberty; and but few persons in after-life altogether escape them. All circumstances which determine blood to the rectum, or which impede its return from the pelvis, tend to produce this disease. There is in many persons a natural predisposition to the complaint, which may be hereditary. But a predisposition is most frequently acquired by sedentary habits, indulgences at table, and excitement of the sexual organs. Hæmorrhoids, though a common disease in both sexes, occur more frequently in males than in females. Few women bear children without becoming in some degree affected by them; but the urinary and genital disorders of the other sex, combined with freer habits of living, leading to congestion of the liver, are still more fertile sources of piles.

Symptoms.—The symptoms produced both by external and internal piles vary greatly in different subjects, and in different stages of the complaint.

External piles cause a feeling of heat and tingling at the anus. A costive motion is followed by a burning sensation, and the excrescence becomes swollen and tender on pressure, so as to render sitting uneasy. This congested state of the pile may pass off; or it may lead to inflammation accompanied with considerable enlargement of the hæmorrhoid, forming an oval tumour, red, tense, and extremely tender. The inflammation may subside or go on to suppuration. When the matter is discharged, a clot of blood escapes with it, the abscess closes, and the dilated vein is usually obliterated, the pile being reduced to a small flap of integument. External piles rarely give rise to bleeding.

Internal piles, when slight, may exist for years, causing little inconvenience besides slight bleeding after a costive motion; with occasionally a feeling of fulness, heat, and itching just within the anus. If only small, they protrude slightly with the mucous membrane in defæcation, returning afterwards within the sphincter. When of large size, the piles always protrude at stool, and require to be replaced, the patient usually pushing them up with his fingers. In a lax state of the sphincters, and in a loose hypertrophied condition of the mucous membrane from which they spring, hæmorrhoids come down, even when the patient stands or walks about, so as to prove exceedingly troublesome, and to interfere with his taking walking exercise. In consequence of the irritation from pressure and friction to which the protruding piles are liable, their mucous surface becomes tumid and abraded, and furnishes a free mucous discharge tinged with blood, which soils the linen. They are often so sore that the patient is obliged to keep the recumbent posture, the pressure in sitting causing more or less uneasiness.

Persons subject to piles frequently suffer no inconvenience from them until irritated by an unusually costive motion, or by a smart purgative; or when, under the excitement of wine, the growths become congested and inflamed, and cause spasm of the sphincter muscle. Then they have what is termed an 'attack of piles'—that is to say, they experience a sensation of heat, weight, and fulness just within the rectum, followed by considerable pain at stool, and sometimes irritation about the bladder. These symptoms, which are often attended with febrile disturbance, arise from inflammation and swelling of the piles, which afterwards subside, but seldom without leaving some enlargement of the growths. The formation and increase of piles seem indeed to arise chiefly from a determination of blood to the rectum. This is greatly promoted by stimulating drinks, so that some patients never suffer from the complaint except after indulging in this way. They are then rendered sensible of an afflux of blood by a sense of heat or intolerable itching at the anus.

Strangulation.—When internal piles of some size protrude at the anus and are not returned, they are liable to be constricted and strangulated by the external sphincter. The contracted muscle impedes the return of blood, and occasions inflammatory swelling of the piles, which may become strangulated and mortify. In this way hæmorrhoids of large size have been known to slough off, the patient being relieved of the annoying complaint by a sort of natural process. An occurrence of this kind is attended with a good deal of pain and suffering, but is free from danger. In general, the extremities only of one or two of the larger growths perish, and the patients, though experiencing relief, are by no means cured of the disease.

Hæmorrhage.—One of the most common symptoms of internal hæmorrhoids, indeed that from which the name of the complaint is derived, is hæmorrhage, which occurs when the bowels are evacuated. The bleeding varies greatly in amount. Sometimes the motions are merely tinged with a few drops of blood; in other instances the quantity lost is considerable, several ounces being voided at stool. The bleeding may be irregular, occurring only after costive motions, or in certain states of health; or it may take place daily, going on even within the bowel, and producing the usual symptoms of derangement from continued losses of blood, such as blanched complexion, loss of strength, quick small pulse, and even œdema of the feet. The character of the bleeding also varies, being sometimes venous, sometimes arterial. There are persons who are liable to discharges of blood from the hæmorrhoidal veins, either at regular periods, or when, from good living or want of exercise, the habit is fuller than usual. In these cases from three

to six ounces of blood, or even more, pass away at stool, following the evacuation; and the blood which is voided is of a dark colour and evidently venous. Such discharges must not be rashly interfered with. They relieve congestion of the liver and kidneys, help to ward off attacks of gout, and prevent fits of apoplexy; so that in many persons they are rightly regarded as safety-valves. But the bleeding which most commonly occurs from internal piles is undoubtedly arterial, taking place from arteries enlarged by disease. The vessels on the spongy surface of the mucous membrane readily give way when blood is determined to the part in defæcation, or when abraded by the passage of hard fæces. An artery of some size, exposed by ulceration, continues to pour out blood, weakening the patient and giving rise to the symptoms above described. Sometimes a small artery on the prominent part of a protruded pile may be observed pumping out blood. That hæmorrhage of this character is good for the health, is quite a mistaken notion; and it is important that the practitioner should distinguish the bleeding taking place as a consequence of local disease, from that which arises from a constitutional plethora or congestion of the internal organs.

Treatment.—When piles are small and cause but little inconvenience, the treatment is very simple. Persons with this complaint should take wine in great moderation, if at all; and in most instances they would do well to abstain entirely from stimulating drinks. Many individuals never suffer from piles except after taking a glass of spirits and water, or a few glasses of wine. Such persons should become water-drinkers. Active exercise in the open air should be taken daily, and the patient should avoid sitting too long at the desk, because it is by prolonged sedentary occupation and the neglect of the rules of health that hæmorrhoidal complaints are induced. Chairs with cane seats are to be recommended. The bowels must be carefully regulated, so as to avoid hard and costive motions, as well as frequent action. Irritating the rectum by active and repeated purging is more hurtful even than constipation. On the other hand, when the liver is congested, or its secretions are sluggish, and when the bowels are costive, a mild cathartic, by clearing the intestines, especially the colon, unloads the congested vessels, and relieves the piles. Lenitive electuary, rendered more active when necessary by the addition of tartrate of potash, may be taken at bedtime; or the compound liquorice powder of the Prussian pharmacopœia, Carlsbad salts, or the foreign mineral waters—the Pullna, the Friedrichshall, or the Hunyadi-Jànos—taken in the morning fasting, answer well with many persons, and ensure a comfortable relief. Half a pint of cold spring water injected into the rectum, in the morning after breakfast, has a very beneficial effect on the hæmorrhoids, by constringing the vessels, and softening the motions before the usual evacuation. The relief afforded by this treatment, combined with care in the mode of living, is often remarkable. Ordinary venous bleeding may be stopped in this way. If necessary, iced water, or an astringent injection, such as a solution of tannic acid or infusion of rhatany, may be used; or an astringent suppository. When the bleeding is arterial, injections are not so successful, and operative treatment often becomes necessary. When there is a slimy discharge from the surface of an exposed internal pile, benefit may be derived from the daily application of tannic acid, mild citrine ointment, or the solid sulphate of copper.

External piles, when large and troublesome, and internal piles when of such a size as to protrude at stool and to be subject to inflammation, ulceration, and frequent bleeding, can be removed only by operation. T. B. Curling.

HÆMOSTATICS (*αἷμα*, blood, and *στατὸς*, stopped).

Definition.—Internal remedies and local applications which arrest hæmorrhage.

Enumeration.—The chief hæmostatics are:—The Ligature; Pressure; Rest; Cold; the Actual Cautery; Astringents; and the whole class of Styptic drugs.

Actions and Uses.—When taken in their widest sense, it is evident that hæmostatics must include all the various means which have been devised to stop bleeding. Externally we must vary our plan of treatment according to circumstances. No surgical principles are better founded than those which enjoin us to tie a wounded artery, and to apply pressure to a vein; and for the absolute arrest of hæmorrhage from any readily accessible part a most powerful aid has lately been provided in Esmarch's elastic bandage. When the bleeding depends on general capillary oozing, the application of ice may often prove effectual; and where this fails, recourse must be had to some of the numerous articles of the pharmacopœia, already referred to, which are endowed with styptic properties. (*See* Styptics.) An example of the successful application of a hæmostatic is the arrest of uterine hæmorrhage by means of injections of perchloride of iron.

In the case of undue hæmorrhage from a leech-bite, if milder remedies, such as pressure, do not succeed, we may apply the solid nitrate of silver, or include the bleeding point in a loop of twisted suture. Absolute rest is essential for the successful treatment of hæmorrhage; and the regulation of the diet and of the bowels is equally to be attended to. For the details of treatment in each particular form of hæmorrhage, the reader is referred to Hæmatemesis, Hæmophilia, Hæmoptysis, Melæna, &c.

Robert Farquharson.

HÆMOTHORAX. *See* Hæmato-thorax.

HAIR, Diseases of.—Aberrations of the hair from the normal and healthy standard may be comprised under three heads—*quantity*, *quality*, and *direction*.

Alterations in quantity.—As regards quantity of the hair, there may be either *excess* or *diminution*.

Excess of hair.—Excess may be the consequence of multiple development from the follicles, leading to the production of a greater number of hairs than usual; or it may result from excessive growth, which brings into view the usually invisible hairs of the body, more or less generally

or partially. Of the latter kind are the hairy men and women of whom so many instances are recorded; and the abnormal growth of hair on parts of the body where its presence is normally but little perceptible, for example, on the face of women, in the form of moustache, whisker, or beard. The hair of the head, as well as that of the beard, sometimes attains an excessive length. Moreover, hair may be abnormal in situation as well as in growth, as seen in the varied examples of pilous nævi.

Diminution of hair.—Diminution may present itself as shortness in length from slowness of growth, or numerical deficiency from arrest of growth; and the latter may proceed onwards to baldness more or less complete. *See* BALDNESS.

Alterations in quality.—Alterations of quality of the hair are manifested by variations in its *physical conditions*, alterations of *colour*, and pathological changes of *structure*.

Physical conditions.—The hair, normally smooth, lustrous, soft, and elastic, may become rough, dull, harsh and rigid, or brittle.

Colour.—Alteration in colour of the hair usually ranges between the lighter tints of childhood and the darker hues of the adult, and the arrest of pigmentation which gives rise to the greyness of every period of life and the hoariness of old age. Absence of pigment, complete or partial, is sometimes congenital. Alterations of the colour of the hair occasionally take place during the course of a serious illness; or the hair may become blanched in the space of a few hours from mental disturbance. There is another aberration of colour of the hair, which consists of an alternation of brown and white in narrow segments, extending from end to end of the hair—a kind of 'ringed' or 'banded' hair. A few examples of this peculiar change in the hair have been preserved and recorded.

Structure.—Aberrations in structure of the hair are shown by its atrophy or attenuation; by its defective consolidation; by a pathological alteration of its elementary constituents; and by the morbid changes induced by syphilis. It is not uncommon to find the hair dwindled to a mere vestige of its original bulk; and, when this takes place, it is apt to break off near the point of attenuation, and present the appearance of a club-shaped stump. Broken hairs of this character, with filamentary pedicles, are found at the circumference of a spot of alopecia areata. Or the hairs may be fragile in texture, and break partially through at short distances, so as to give a speckled appearance to the hair-shaft. This change is generally met with in the thick hairs of the whiskers and beard, and is termed *trichoclasia* or *fragilitas crinium*. In tinea the formative cells of the hair retain their elementary fœtal form, or proliferate in the substance of its shaft, rendering it brittle and causing its destruction; the cell-proliferation constituting the trichophyton among the parasitic fungi. In syphilis, the hairs of the whiskers and beard have been found swollen, as though varicose, and discoloured from imperfect cell-development.

Alterations in direction.—Altered direction of the hair is met with on the edges of the eyelids, where the hair may grow inwards and press against the cornea, so as to give rise to conjunctivitis; this form of affection being termed *trichiasis*. The matting or felting of the hair in *plica polonica* may likewise be ascribed to misdirection, though in a different sense, namely, as resulting from neglect.

ÆTIOLOGY AND PATHOLOGY.—Numerical quantity of hair can be considered pathological only when that quantity interferes by its *excess* with the comfort and convenience of the individual. This can rarely occur when the hair is produced in normal situations, and grows to excessive length, the remedy being obvious. But when it is developed on the face of the female in the form of moustache, whiskers, or beard, it is then an annoyance very nearly approaching to that of a disease. This is still further increased when the greater part of the body becomes invested, as sometimes occurs, with a thick, hairy covering. An excess of pilous growth is, in general, a mere augmentation of a natural function; occasionally, it appears to be the result of a substitutive function, as in sterile females, or when the procreative power is exhausted through age; and at other times, as in pilous nævi, it is due to abnormal organisation of the affected skin.

Diminution of quantity of hair, and arrest of pilous growth, must in every instance be due to aberration of nutrition, and atrophy of the formative papillæ of the hair. This may be the consequence of debility, however induced, whether by age or disease. Very commonly the hair breaks away from the papilla without undergoing any previous alteration of figure. At other times it becomes attenuated and starved before it eventually drops off. Sometimes the nutritive power is simply suspended; while at other times it is completely arrested, temporarily or permanently, and gradually or on a sudden. After serious illness the hair is apt to fall off; not unfrequently this occurs after puerperal confinement; dropping off of the hair is known to be a frequent concomitant of syphilis; and it presents the characteristics of a nerve-lesion in *alopecia areata*. In cases of universal baldness the skin is soft, pulpy, and feeble; deficient in colour as well as in firmness and tone; and smooth from the absence of papillæ.

Alteration of *colour* of the hair is generally attributable to variations in quantity, and modification of pigment. But in cases of sudden blanching of the hair, the apparent whiteness has been found to depend on the rapid development of a gaseous fluid within the substance of the hair, obscuring the pigmentary granules to which its colour is due. This has likewise been observed to be the case in the instance of ringed or banded hair.

Alterations of *structure* of the hair are for the most part due to modifications of development and growth of its constituent cells. The elementary cells may be produced in greater or less quantity, changing the bulk of the hair; they may be more or less abundantly and completely converted into hair-fibre; they may retain permanently their undeveloped or cell-character; or they may become the subject of an abnormal proliferation within the shaft of the hair. As the firmness, elasticity, and pliancy of the hair are due to the perfection of its development, so the

opposite qualities are referable to abnormal development. The shaft of the hair often varies in its diameter; the medullary space equally varies; it may be fractured completely, as in ringworm; or partially, and with slight force, as in *trichoclasia*. The hair of ringworm is made up of round cells and proliferating cells, with a deficiency of fibrous structure; hence it dries and shrivels up as though withered, or breaks off close to the head, leaving behind short stumps. When syphilis attacks the hair, its structure is likewise rendered brittle.

Treatment.—The therapeutical treatment of the diseases of the hair may be summed up very briefly. Where the hair is in excess it must be removed; where it is deficient it must, if possible, be restored; and where its structure is altered, it must be repaired by renovating the health of its formative organ, the skin.

Contrivances for removing the hair are termed depilatories; they act for the most part by destroying and dissolving the hair. Their application requires caution, on account of their irritant qualities, and they are open to the objection of being merely temporary in their effects. The only trustworthy depilatory is the razor. *See* Depilatories.

For defect of growth in length, as also in quantity, we must have recourse to tonic or stimulant remedies. Tonics, such as arsenic, quinine, and iron, improve the nutritive power of the skin; and stimulants for external application arouse the energies of the tissues of the skin, more especially those of the blood-vessels and nerves. The usual stimulants adopted for this purpose are ammonia, cantharides, mustard, the various stimulating liniments, and acetic acid. *See* Baldness.

For the purposes of fashion or convenience, the colour of the hair may be discharged by solutions of oxygen, notably the peroxide of hydrogen; and also by alkalies, with more or less injury to the hair. It may be restored artificially by the various hair-dyes, which are either temporary or permanent. Of the former kind are the permanganate of potash, and the black oxide of lead; and of the latter the black oxide of silver.

Alterations of structure of the hair due to debility of the skin require the aid of constitutional tonics and local stimulants. Where ringworm is the cause of the morbid change of the hair, there is a chronic inflammation to be subdued, as well as a feebleness of nutritive power to be repaired. In the fall of the hair from syphilis, the specific remedies for that disease are required.

Aberration of direction of the hair may be corrected by avulsion with the forceps; and the felting of the hair in plica polonica may be prevented by ordinary care and attention.

Erasmus Wilson.

HALL, in Austria. Common salt waters. *See* Mineral Waters.

HALLUCINATION (*hallucinor*, I blunder).—A false perception of an organ of sense, for which there is no external cause or origin (*see* Illusion); as when a man in total darkness thinks he sees an object. Hallucinations of all the senses occur, the most frequent being those of sight and hearing. They may be found in persons not insane, but indicate a disordered state of brain.

HANGING, Death by.—Hanging is the effect of suspension of the body by the neck by means of a ligature or noose, the constricting force being the weight of the body, wholly or in part, or the weight multiplied by the distance through which the body falls. The mode of death varies according to these circumstances. With a long drop, the method now usually employed in judicial hanging, and particularly if the knot is under the chin, death is not unfrequently due to fracture, or displacement, of the cervical vertebræ, and injury to the medulla oblongata. Death may also occur, without such anatomical lesion of the cervical vertebræ, from shock or syncope, or, as it is termed by Casper, neuro-paralysis.

When death does not occur in either of these ways, it is the result of asphyxia from occlusion of the air-passages, or rather of asphyxia in combination with coma, caused by compression of the cerebral blood-vessels. Though compression of the carotids and jugulars may be maintained for a considerable time without a fatal result, if the trachea is open below the point of constriction, whereas death speedily ensues if the air-passages are also occluded, yet death may result from the disturbance of the cerebral circulation alone, and the two causes always operate conjointly in every case, in varying proportions.

Phenomena.—When death is not instantaneous, as in cases of injury to the medulla, or from neuro-paralysis, convulsive movements of the type seen in asphyxia may continue for some minutes after suspension, and the heart may continue to beat for a considerable period after all other vital movements have ceased.

Subjects who have been partially hanged have described various sensations, more or less pleasurable, similar to those of cerebral congestion and narcotic stupor.

Post-mortem Appearances.—The appearances found after death by hanging are not uniform or constant; and there is no single sign invariably present diagnostic of death by hanging. Indicative of suspension, but not necessarily of death so caused, is the mark of the cord on the neck. Usually it is above the hyoid, passing obliquely upwards behind the ears, and losing itself in the occiput. But the position may vary according to the tightness of the noose before suspension, or the position of the head and direction of the pressure. It is generally single, but if the cord should have been twisted twice round the neck, two marks may be found, one circular and the other oblique. The characters of the mark differ somewhat according to the texture and thickness of the ligature. Usually it is a shallow groove or furrow of a whitish or brownish hue and parchmenty consistence, occasionally abraded, rarely ecchymosed; but it may have livid edges or a chocolate tint. The appearances may vary in different parts of the same mark. The subcutaneous cellular tissue is compressed and silvery. Occasionally minute extravasations are seen in the deeper layers of the skin. The

middle and internal coats of the carotids are sometimes lacerated; and where the momentum has been great, lacerations of the cervical muscles, fracture of the larynx, rupture of the thyro-hyoid ligaments, and fracture or dislocation of the cervical vertebræ, with injury to the medulla and effusion into the spinal canal, have been found. All the appearances usually found in the neck in cases of hanging may be produced by suspension of the dead body, especially if the legs are pulled forcibly downward.

The face is sometimes, but not commonly, distorted and expressive of suffering. Usually it is placid and pale, though if the body have hung for some time, it becomes very livid. The eyes are sometimes very prominent, and the pupils are usually dilated. Frothy mucus may be found at the mouth and nostrils. The tongue is pressed against the teeth and indented, or it may be clenched between the jaws. The base of the tongue is injected. The hands are often tightly clenched, the nails even being driven into the palms. Erection, or semi-erection, of the penis in men, with expulsion of semen or prostatic fluid, and vascular turgescence of the genitals in females, with sanguinolent effusion, are frequently observed. Expulsion of the contents of the bladder and rectum is likewise common. The condition of the brain varies. Congestion is sometimes pronounced, at other times not very marked. The mucous membrane of the larynx and trachea is congested, and mucous froth is present. The lungs are at times pale and distended; at other times collapsed. The condition of the heart and venous system characteristic of asphyxia is common. Marked redness of the mucous membrane of the stomach, simulating irritant poisoning, has been occasionally noted. The determination of the fact of death by hanging depends on a consideration of these various phenomena, and the absence of other causes of death.

Accident, Suicide, or Homicide?—Hanging is rarely homicidal. It signifies great disproportion of strength between the assailant and the victim; and, therefore, in the absence of this condition, there will be injuries indicative of a struggle. Apart from collateral circumstances, homicide can only be argued from the presence of such injuries as could not have been self-inflicted, or caused accidentally during the act of suspension. Occasionally hanging is accidental, as in foolish experiments and insane imitation. It is not necessary that the body should be entirely off the ground to cause death by hanging. Many instances are recorded of suicide by hanging in most extraordinary positions calculated to throw the greater part of the body-weight on the noose.

Treatment.—This is rarely called for, except in accidents or attempted suicide. The body must be cut down, and artificial respiration employed. Venesection may be had recourse to for relieving cerebral congestion. *See* Artificial Respiration; and Resuscitation. D. Ferrier.

HARROGATE, in Yorkshire. Saline, chalybeate, and sulphur waters. *See* Mineral Waters.

HASTINGS, on the South-East Coast of Sussex. A mild climate. Mean winter temperature, 39° Fahr. Exposed to the east, but sheltered from the north. *See* Climate, Treatment of Disease by.

HAUT MAL (Fr.)—A synonym for epilepsia gravior. *See* Epilepsy.

HAY FEVER.—Synon.: *Catarrhus æstivus*; Bostock's catarrh; Hay asthma; Fr. *Asthme d'été*; Ger. *Frühsommercatarrh.*

Definition.—A catarrhal affection of the mucous membrane of the eyes, nose, mouth, pharynx, larynx, and bronchi, accompanied by dyspnœa; induced by the action of the pollen of various plants, chiefly of the graminaceæ; prevalent during the hay season, but subsiding at its close; and varying in severity according to certain atmospheric conditions, and the amount of pollen present in the air.

Ætiology.—Hay fever exists in Europe generally, but it is by far most common in England, where the annual number of cases is double that of any other country. It prevails more among men than women, probably because the former are most exposed to the atmosphere; and inhabitants of towns visiting the country are more liable to attack than the country people themselves. It has been ascribed by some writers to the sun's heat in the summer months, also to certain odours, vegetable and animal; but the experiments of Mr. C. H. Blackley show it to be due to the specific influence on certain mucous membranes of the pollen grains of the following natural orders of plants:—Ranunculaceæ, Papaveraceæ, Fumariaceæ, Cruciferæ, Violaceæ, Caryophyllaceæ, Geraniaceæ, Leguminosæ, Umbelliferæ, Rosaceæ, Liliaceæ, Compositæ, Graminaceæ, and others, both exotic and native. Pollen was applied to the mucous membrane of the (1) nares, (2) larynx, trachea, bronchial tubes (by inhalation), (3) conjunctivæ, (4) tongue, lips, and fauces; and in all these cases it produced the symptoms of hay fever, the pollen of grasses being most potent. Amongst these secale cereale, or rye, exercised most marked effects, though greater influence is generally attributed to anthoxanthum odoratum.

It has been found that large quantities of pollen float in the air during the summer months; and that the number of cases of hay fever depends on the amount present, which increases in warm damp weather, decreases when it is very dry and hot, and often nearly disappears after heavy rain. Cold weather reduces the number of sufferers by checking the inflorescence of plants. The higher strata of the atmosphere appear to contain more than that immediately overlying the soil, and Mr. Blackley found the greatest number of pollen-particles at between 1,000 and 1,500 feet above the earth's surface, whither they are probably carried by aërial currents. The number of pollen-grains present reaches its maximum in June, when Mr. Blackley collected 880 in a day on a square centimetre of glass. The size and forms of the pollen-grains vary greatly in the different species, but this does not seem to influence their action, which appears to depend on the pollen-sac absorbing moisture from the contiguous mucous membrane and bursting, when the minute granules it contains are thus extruded, and cause irritation.

Symptoms.—An attack of hay fever generally occurs without any premonitory disturbance, immediately on the application of the pollen to the mucous surfaces, for instance, when the person enters a hay-field. The first symptoms are itching of the parts with which the particles come in contact, beginning with the hard palate and fauces, and then extending to the nostrils, the eyes, and face, though, if the wind be strong, the eyes may be first attacked. The catarrhal stage follows, marked by violent fits of sneezing, and running from the eyes and nose, with occasional pains in the head and in the frontal sinuses; then the submucous tissue of the nares swells; and in a short time both nostrils become blocked and impervious to air. A change to the recumbent position, however, if the patient lies on one side, will often reopen the uppermost nostril, while the other, from the force of gravity, becomes still more occluded. The sneezing will continue without fresh application of pollen, as at night, when the subsidence of the swelling restores, or even exaggerates, the sensibility of the Schneiderian membrane. The alæ nasi become red and inflamed, and occasionally bleed. The discharge after this becomes less in quantity, inspissated and puriform, and finally subsides. In the eyes, the swelling of the submucous tissue causes closure of the lachrymal canals and nasal ducts, and considerable injection of the conjunctival capillaries is apparent. Sometimes, but rarely, œdema of the eyelids follows. Similar to the nose-symptoms are those occurring in the throat, some swelling taking place in the pharynx, which gives rise to partial closure of the Eustachian tubes, and hence to a certain degree of deafness. Slight feverishness is occasionally present, the pulse quickening to 100, and the temperature slightly rising; but in a large number of cases pyrexia is entirely absent. The changes which take place in the mucous membrane of the air-passages give rise to asthmatic symptoms, such as tightness of the chest, difficult and wheezy breathing, with prolonged expiration, and some dry cough, followed, at the close of the attack, by expectoration.

The catarrhal symptoms are, however, more characteristic than the asthmatic, which are not invariably present.

The liability to attack lasts generally from three to four weeks in summer, but its duration depends on the presence of the exciting cause, which, if not removed, may cause the malady to last for months. A fall of rain will diminish the disorder by clearing the air of pollen; exercise, which increases the number of respirations and, therefore, of pollen-grains inspired, will render it more severe; while each attack makes the individual more susceptible to this subtle influence, and, consequently, augments the probability of other seizures. As a rule, hay fever has no complications, and passes away completely on the removal of the exciting cause. Constant recurrence of the attacks has been noticed to lead to deafness, owing to catarrh of the Eustachian tubes.

Diagnosis.—The diagnosis of hay fever from other affections is easy, as the occurrence of the catarrhal symptoms only in summer separates it from an ordinary 'cold in the head'; while their combination with dyspnœa in hay fever prevents it being mistaken for spasmodic asthma arising from other causes, in which there is usually no catarrh.

Prognosis.—The prognosis is favourable if the patient be removed from the exciting cause, as the asthmatic symptoms seldom, if ever, lead to pulmonary emphysema, or to any permanent change in the bronchi.

Treatment.—The most obvious course in the treatment of hay-fever, but not always the most easy one, is to avoid exposure to pollen. Mr. Blackley notices that a small amount of this material might exist without giving rise to hay fever, but if ten grains of pollen were detected on the glass slide exposed to the air for twenty-four hours, symptoms were sure to appear in persons liable to it. Sufferers from this complaint should avoid hay-fields, hayricks, and much exposure and exertion in the country during the hay season, and should remain to a great extent within doors; but where circumstances admit, change to the seaside is highly desirable, and it generally effects a speedy cure. Even on the coast some care must be taken to select a locality free from vegetation; for if the wind blows from the land, where hay-grass be flowering at the time, an attack may be induced. Choice should be made of a seaside place backed with high cliffs, and where the prevailing winds are from the sea. Of other localities, high mountain stations, where there is more grazing than hay-growing, and closely inhabited cities with few parks or grassy squares, are to be preferred. Cotton-wool and other respirators available are sometimes used with advantage.

The medicinal treatment consists in first combating the general predisposition to the complaint by tonic measures; and, secondly, in allaying the local irritation.

The first object is best achieved by shower baths, and by such tonics as iron, quinine, nux vomica, sulphate of zinc, and arsenic. Lotions of sub-acetate of lead or sulphate of zinc applied to the eyes and inner surface of the nostrils give some relief; but the writer has found the most successful results from the use of the spray-apparatus, containing solutions of carbolic acid (eight grains to an ounce), sulphurous acid (equal parts with water), sulphate of quinine (two grains with acid to an ounce), and tannic acid (four grains to an ounce). The spray may be applied to all the irritated surfaces—eyes, nose, throat, and larynx—with great relief. C. Theodore Williams.

HEADACHE.—Synon.: Cephalalgia; Fr. *Douleur de tête*; Ger. *Kopfschmerz*.—Pain or uneasiness in the head is very variable in its nature, and produced by a great number of causes. It is present at some period or other in the course of most acute, and many chronic diseases; and may be associated or not with organic change in the brain, or in other organs of the body.

Symptoms.—Headache presents many varieties. It may be slight or most intense; superficial or deep-seated. It may be more or less confined to particular parts, as the forehead, the temples, the occiput, or vertex. Sometimes the pain is limited to one spot, producing the sensation as if a nail were being driven into the head, when it is called *clavus*. It may extend over one side of the head,

as in hemicrania or megrim; or be generally diffused. Headache presents every variety of character—dull, sharp, cutting, &c. Its accession may be sudden or gradual; and the paroxysms may be of the shortest possible duration, or may extend over hours, days, or months. The pain may be simple, or associated with various perverted sensations, such as giddiness, tingling in the limbs, disordered hearing, or disturbances of vision.

Varieties.—For practical purposes headaches may be arranged in the following order:—

1. *Structural headache*, or headache dependent upon disease within the cranium.
2. *Congestive headache.*
3. *Nervous* or *sick headache*—hemicrania or megrim.
4. *Toxæmic headache.*

1. *Structural headache.* This may be due to any of the many forms of disease of the brain, or of its membranes, such as meningitis, cerebral softening, abscess of the brain, cerebral tumour, &c.; or it may be premonitory of cerebral softening. It is nevertheless often wanting in these disorders, and the locality of the pain, when present, by no means corresponds with that of the lesion. As a rule the pain of organic disease is fixed and habitual, though sometimes, as in abscess or cancerous tumour, it may be of an intermittent character. If there be sickness associated with it, the sickness occurs without any apparent gastric disorder, and the pain continues after the sickness ceases. Stooping and even the recumbent posture aggravate the pain, whilst it is lessened by elevating the head. If organic disease be suspected, the collateral symptoms must be carefully scrutinised and weighed. It rarely happens that organic disease needs to be inferred from pain alone.

2. *Congestive headache.* Many forms of headache depend upon a greater or less degree of congestion of the vessels of the brain; the congestion being either active or passive.

Active congestion may be caused by hypertrophy of the left ventricle of the heart, general plethora, catamenial irregularities, mental or emotional excitement, and other conditions. The pain in such cases is of an obtuse character, affecting the whole or a part of the head, particularly the forehead and occiput. It is accompanied with a sense of pulsation in the ears, flushed face, glittering eyes, and giddiness on stooping.

Passive congestion may be produced by dyspnœa, by asthma, by valvular defects in the heart, or by defective action of the liver, bowels, and skin; it may be the after-effect of drunkenness; or may result from any cause which can produce a state of debility in the vessels of the brain, such as general anæmia, exhaustion from fatigue, loss of blood, leucorrhœa, or that following over-excitement, mental exertion, or bodily fatigue—causes which all favour congestion. When the headache is induced by anæmia or debility, the pain is most generally across the forehead or at the top of the head.

3. *Nervous* or *sick headache, hemierania* or *megrim.* This disorder is discussed in a separate article. *See* Megrim.

4. *Toxæmic headache.* The headache which attends all fevers and inflammatory disorders, though due in some measure to cerebral congestion, is chiefly caused by the action of the blood, altered in character and elevated in temperature, on the nervous elements of the brain. In uræmia likewise the headache which frequently precedes or accompanies the other symptoms pointing to the existence of renal disease, results from the morbid condition of the blood. So also in some persons, breathing the impure air of a crowded room, or the products of the combustion of gas, will, by the imperfect decarbonisation of the blood, speedily produce a headache.

Besides the above varieties of headache, pain about the head external to the brain may be produced by *rheumatic* affections of the scalp, with tenderness of the skin and rheumatism in other parts; by *syphilitic* affections of the periosteum or bone; by *inflammation* of the scalp, commencing erysipelas, &c.; and by trigeminal and other varieties of *neuralgia.* From neuralgia headache may be discriminated by its mode of accession; by the generally longer duration of the attack; and by the more complete intermissions.

Treatment.—The treatment of headache must necessarily depend upon the peculiarities of each individual case. In organic or toxæmic headache the disease with which it is associated, and not the symptom itself, will of course be the object of consideration, and the treatment will be found discussed in connection with these special morbid states. The same remark applies to many forms of congestive headache, such as those produced by disease of the heart, asthma, &c. If catamenial irregularities or uterine disorders are the exciting cause, these must be treated by appropriate measures. If anæmia or debility be present, then in the intervals between the paroxysms, iron in some form, either alone or in combination with quinine or some vegetable bitter, must be given. During the paroxysms a little sal volatile, a cup of soup or strong tea or coffee, or some weak alcoholic stimulant may be of service. Where anæmia is not a prominent symptom, or when the disorder assumes a periodical or intermittent character, quinine alone, in doses of two or three grains twice or three times a day, may be given; and if this fails to afford relief, arsenic is often of signal service. Great benefit is frequently afforded in the latter cases by the administration during the paroxysm of alcohol. Except when the headache is associated with general plethora or active congestion, strong purgatives are to be avoided, and the bowels are to be regulated by the mildest aperient which will answer the purpose. The patient's habits and mode of life must also be strictly regulated; and care must be enjoined as to diet, sleep, clothing, and exercise, especially if the headache be associated with dyspepsia. If dyspeptic symptoms are prominent, or if the pain be connected with a gouty diathesis, then these disorders must be treated with their appropriate remedies.

If during the paroxysms the head be hot and the face flushed, warm or cold lotions, iced water, or eau-de-Cologne may be applied; a warm douching may be useful in some cases. Occasionally in severe attacks a few leeches may be placed on the temples with advantage, or a blister to the nape of the neck, but never if the face be

pale, and the pulse feeble. Compression of the temporal arteries with a pad, sustained pressure around the head, or holding the arms high above the head, will sometimes relieve severe headache.

The treatment of sick-headache is discussed under the article MEGRIM. P. W. LATHAM.

HEALTH, Maintenance of. *See* DISEASE, Causes of; PERSONAL HEALTH; and PUBLIC HEALTH.

HEARING, Disorders of.—These disorders may be grouped under three classes, namely:—(*a*) *Partial or complete loss of hearing*, or *deafness*; (*b*) *Exalted hearing* (so-called); (*c*) *Perverted hearing* or *Tinnitus*. They may be due to various conditions quite independent of any actual disease of the auditory apparatus, and only such causes of disordered hearing will be considered in the present article as are not due to changes in the conducting portion of the ear, which can be demonstrated by the different methods of examination, or to recognised affections of the nervous apparatus connected with hearing. These will be found discussed under the article EAR, Diseases of.

(*a*) *Partial or complete loss of hearing.*—Perhaps the deafness due to accumulations of cerumen, which so frequently interfere for a time with the hearing of persons whose ears are free from disease, should be regarded as disordered hearing, rather than as a symptom of a pathological condition. As nothing more energetic than careful syringing is required to remove such obstructions, it will be sufficient to observe that in this proceeding the nozzle of the syringe should be directed along the roof of the external canal. Amongst a very large number of people with the organs of hearing in an apparently healthy state, some few will be found upon whom, throughout their lives, certain notes produce no response. They will not, for example, be able to hear the sounds made by grasshoppers, or the singing of some birds—the call of a partridge, for instance; and in most persons, as age advances, the very high notes are lost. To prove this, it is only necessary to blow one of Mr. Galton's whistles in a room full of people, when a considerable proportion of the assembly will fail to catch the high notes, which are distinctly heard by the rest; and although this failure is also noticeable in many nervous affections, all other sounds will perhaps be heard quite normally by these individuals. Emotional influences play a very large part in the destruction or suspension of hearing, and this is especially observable in the case of women. The unexpected sight of a dead husband, hearing of the death of a dear friend, the proposal of a severe surgical operation on a relative, a quarrel, an alarm of thieves, and witnessing a carriage accident, have each within the knowledge of the writer been followed by intense and sudden deafness, which has only been partially recovered from. The same effect has been noticed with men who have been subjected to prolonged mental strain, in connection with literary work, or during commercial crises. It has been recorded that a deaf and dumb child has suddenly recovered hearing, after the discharge from the bowels of eighty-seven lumbrici, and a large number of oxyurides (*Journal of Med. Society*, 1844). Complete loss of hearing, extending over several months, was on one occasion followed by perfect hearing in a girl of fifteen, on the first appearance of menstruation. The temporary effect of quinine and salicylic acid on the hearing is well known, but when quinine has been administered in large doses, and for a long period, this special sense is not unusually injured permanently. Amongst the diseases which often induce a lasting deafness, without any perceptible local change in the conducting portion of the ear, may be included mumps, many of the fevers, and diphtheria; for although in the two latter examples the middle ear often suffers, this is not always the case, and the immediate cause of the deafness must be sought in the products of inflammation which have been left within the cranium. The same explanation is probably also the correct one in those instances where children lose for ever all hearing power, after cerebral excitement or congestion. Habitual and obstinate constipation is sometimes attended with loss of hearing, which returns after the action of purgative medicine. A clot of blood within the cranium, whilst causing hemiplegia of the opposite side, may destroy the hearing of the same side as the effusion; and a case is on record in which closure of the cerebro-spinal foramen gave rise to this symptom.

(*b*) *Exalted hearing.* — What is termed *exalted hearing* will generally, on careful examination be found to be not so much a definite change in the capacity of the hearing apparatus to receive impressions, as an inability on the part of the patient to receive such impressions without an undue effect on the nervous centres being produced. Thus in many inflammatory states of the brain or its membranes this symptom is often a prominent one. It is also not uncommonly met with in hysterical and nervous persons.

(*c*) *Perverted hearing.*—Attendant on most of the above examples, and closely allied to deafness, is the often persistent tinnitus; but there are conditions in which this distressing symptom is the chief and solitary trouble. Thus tinnitus, with a feeling of pulsation in the ear, is occasionally the first warning of an intracranial aneurism; whilst a furious tinnitus and the hearing of strange noises sometimes precede an attack of acute mania. Patients who have been the subjects of malarial fevers and sunstroke often complain of tinnitus; and, as in all cases of disease of the ears, when present it is the most intractable of symptoms, so it is when the ears have not been the seat of any malady or injury.

TREATMENT.—Insomuch as all the above states of disordered hearing may strictly be said to be due to causes which are in themselves abnormalities of one part or another of the organism, it is to these that the treatment will naturally be directed rather than to alterations in hearing which in truth are merely symptoms. *See* EAR, Diseases of; and TINNITUS. W. B. DALBY.

HEART, Diseases of.—The study of this class of diseases has reference to the immediate pathological changes which occur in the heart itself, and to the consequences or results of these changes upon its function, that is to say, upon the circulation of the blood. The latter

portion of the subject will be found discussed under the head CIRCULATION, Diseases of Organs of; and it will therefore be necessary in this place to summarize only the morbid changes which affect the heart itself, and this merely as an introduction to the full description of those changes contained in the articles which follow here, or which will be found in other parts of this work.

1. The heart may be *displaced*, *misplaced*, or *malformed*. 2. Its various textures, including the coverings, the lining membrane, the valves, and the walls, are liable to *acute* and *chronic inflammation* and their effects. 3. The organ itself may be increased in size, either by general *dilatation* of one or of more of its cavities, or partially, as by *aneurism* of the walls; or by the addition to its volume, by *hypertrophy* of its *muscular* structure, of the *fatty* tissue which exists beneath the pericardium, or of the *connective tissue* which binds the muscular fibres together. 4. Its volume may be diminished by simple or general *atrophy*; or by the walls of one or more of its cavities being wasted and thinned. 5. Its walls are liable to various forms of *degeneration*—more especially *fatty*, *granular*, *calcareous*, and *pigmentary*. 6. They may be the seat of *fibroid disease*; and of various *morbid growths*, such as *cancer*, *tubercle*, and *syphilitic formations*, or *hydatids*. 7. *Congestion* and *hæmorrhage* may occur in the walls of the heart. 8. These are liable also to such injuries as *rupture*—whether spontaneous or as the result of violence; and to various kinds of *wounds* and their effects. 9. And lastly, the reader will find discussed under the head of *functional disorders* of the heart, certain disturbances in its action and sensibility which cannot be clearly referred to any structural lesion.

HEART, Abscess of. *See* HEART, Inflammation of; and HEART, Pyæmic Abscess of.

HEART, Aneurism of. — DEFINITION. — A depression or a sacculus formed in the walls of the heart, communicating with one or more of its cavities.

The term aneurism of the heart has not been always used in this sense. It was first applied by Lancisi and subsequently by Bouilleau to every dilatation of the heart, whatever its cause or its character. The first case of the disease, as the term is now understood, was published by Galeatti in 1757. In this country, Dr. Thurnam, Dr. Peacock, and others have treated the subject fully. In France aneurism of the heart has been described specially by Breschet and by Pelvet; whilst in Germany, Lobstein, Löbl, and Hartmann have written upon it at length. A full account of the researches of these and several other writers will be found in the work of M. Pelvet—*Des Anévrysmes du Cœur*, Paris, 1867.

ÆTIOLOGY AND PATHOLOGY.—The essential condition which leads to aneurism of the heart is a change in a portion of the heart's texture, by which the resisting power of the affected part against the pressure of the blood from within the cavity is diminished. Under such circumstances a simple depression, corresponding to the weakened spot, may be first formed on the inner surface of the heart. This gradually continues through the cardiac wall towards the external surface, where the resistance becomes less, and where a pouch or sac is then formed, communicating with the cavity of the heart, it may be by a neck. The weakened condition referred to is attributable in different instances to inflammation of the substance of the heart, whether acute or chronic; to syphilitic or other growths; and to fatty degeneration.

(*a*) *Inflammation* of the heart, affecting either the endocardium or the substance of the heart itself, may lead to ulceration and softening; and both conditions have been found in connection with aneurism. Inflammation may also lead to the formation of pus in the walls of the heart; and cases are recorded in which, the contents of the sac thus formed having been discharged into the circulation, the cavity became converted into an aneurismal pouch (Dr. Wilks, *Path. Soc. Trans.*, vol. xii.). Cases of aneurism of this character may be regarded as originating in *acute* inflammation of the heart.

In a still larger number of cases, in which the endocardium and pericardium, as well as the muscular walls, are involved, we find a development of fibroid tissue—a cirrhosis, as it were, of the heart, as the result of *chronic* inflammatory action. In these cases the fibroid tissue is stretched at each systole of the heart, and it returns less and less to its former dimensions, owing to its want of elasticity. Thus by degrees the portion of the heart affected yields and is pushed outwards, forming a sac of a more or less globular shape.

(*b*) *Growths* in the heart, whether syphilitic, or tuberculous, undergoing the process of softening, may lead to the formation of aneurism, as in the conditions just described.

(*c*) *Fatty degeneration* may give rise to the formation of aneurism. First, a circumscribed spot of softened tissue in the wall of the heart, the result of fatty degeneration, yields without rupture, to the pressure of the blood from within, and thus allows of the formation of an aneurismal pouch. Secondly, partial rupture may take place in the muscular wall, and hæmorrhage occurring at this point, constitutes what is called 'cardiac apoplexy' (*see* HEART, Hæmorrhage into the Walls of). The clot thus formed undergoes the changes usual in extravasated blood; and a cyst results, which may ultimately communicate with one of the cavities of the heart. Meriedec Laennec, who wrote on aneurisms of the heart, believed that this form of disease was almost exclusively thus developed.

With reference to the relative frequency of the various causes of cardiac aneurism, just enumerated, the writer finds that out of a total of 56 cases, the histories of which were collected by himself, in 21 the walls had undergone fibroid changes; in 6 there was fatty degeneration; in 3 the disease was the result of ulceration; in 2 cases it appeared to have originated in abscess; and in 24 the materials were not sufficient for arriving at an accurate conclusion.

Age.—With regard to the age at which this disease occurs, in 51 of the 56 cases just alluded to the oldest was eighty-two, the youngest a child of twelve. Two cases occurred between ten and twenty years of age, 9 between twenty and thirty, 8 between thirty and forty, 7 be-

tween forty and fifty, 7 between fifty and sixty, 10 between sixty and seventy, 6 between seventy and eighty, and 2 between eighty and ninety years of age.

Sex.—Of the 56 cases, 39 were males and 17 females.

Anatomical Characters.—Keeping in view the several conditions just described, under which aneurism of the heart can occur, we may expect to find a corresponding variety of morbid appearances. On laying open the pericardium in cases in which aneurism of the heart exists, adhesions which are more or less universal or which may be limited to the seat of the disease, are very frequently found. The heart itself is generally enlarged; and where the aneurism projects externally it is altered in shape, so much so in some instances that the organ looks like a double heart. The sac may project from the walls as a rounded or conical tumour; or, as in an instance that came under the notice of the writer, it may assume the appearance of an elongated sac winding round the base of the aorta. Again, no appearance of anything abnormal may be observed until the heart is laid open, when a depression or an opening may be discovered in the walls of the ventricle, or in the septum. In some instances more than one pouch is formed, in communication with the cavity of the heart by a separate or by a common opening. The size of the tumour may vary from that of a small bean to that of an average-sized cocoa-nut. The opening leading into the pouch may be the widest part of the sac, the aneurism being a mere depression like a watch-glass or half-an-egg; or there may exist a constricted or defined neck, leading to a tumour bulging from the walls. The size of the opening may vary from a couple of inches across, to one capable of admitting only a probe. The neck is, in a few cases, described as hard and cartilaginous; in others, as being smooth and regular, or jagged and irregular. The walls of the tumour may be formed by the dilated and thin walls of the heart; or by the walls considerably thicker than natural, and altered in texture. A very usual condition to find is that the walls of the sac consist, proceeding from within outwards, of endocardium; fibroid tissue, with or without portions of muscular tissue; and pericardium. This condition was described as occurring in eleven cases. In eight cases the walls were said to consist only of the endocardium and pericardium, with fibroid tissue between; but it was found that at the base of the tumour, in all these cases, all the layers of the heart-tissue were present, and that it was only towards the apex of the swelling that the muscular layers disappeared. In three cases the walls of the aneurism were said to be composed of a thin membrane, which appeared to consist of endocardium and pericardium only. In three cases the walls were of cartilaginous consistence, with bony plates interspersed in the tissue. The thickness of the walls of the sac varied from that of paper to three lines or more. In fourteen cases the wall of the tumour was strengthened by the adherent pericardium. The aneurismal cavity in the majority of cases was lined by smooth membrane; but in a few instances, apparently of acute formation, the walls consisted of muscular fibres, torn and separated by the blood which had been extravasated amongst them. The contents of the sac are generally in the form of blood-clots or layers of fibrin, the outermost layers of which may be more or less organised and adherent to the wall.

Seat.—Of the 56 cases already alluded to, 52 were in the left ventricle, 3 in the right ventricle, and 1 in the right auricle. Of the 52 cases in which the aneurism was situated in the left ventricle, 22 occupied the apex, 11 the base, and 17 were in intermediate situations. Several cases have been recorded, in which the aneurism was situated in the muscular septum between the ventricles; in the 'undefended space;' or at the base immediately below the aortic valves. A case of the last-named form was recorded by the writer in the third volume of the *Transactions of the Pathological Society.* These two last forms are generally associated with endocardial inflammation and ulceration.

Symptoms.—In 13 of the 56 cases referred to, the aneurism was not discovered until after death; no mention being made of signs or symptoms of its previous existence. In the remaining cases, symptoms, more or less marked, indicative of heart-disease were present. These symptoms were chiefly—pain, dyspnœa, lividity of the surface, palpitation, and irregularity of the pulse. In 10 cases murmurs were heard, accompanying or replacing the sounds of the heart. We thus see that the symptoms of aneurism are such as may exist in common with other lesions of the heart; and it is extremely doubtful, except in presence of some special circumstances indicative of this condition, whether we have at our command the means of diagnosing the existence of cardiac aneurism. The writer not long since saw, with Dr. Holman, of Reigate, a case of grave heart-disease, in which extended dulness to the left and below the usual situation of the apex-beat, with a feeble impulse in the same situation, led to a suspicion of the probable existence of cardiac aneurism.

Progress, Duration, and Terminations.—Pathological testimony fully justifies the inference that certain cardiac aneurisms—such as those which originate in inflammatory softening, ulceration, or the opening of cysts into the cavities of the heart—are acute in their formation. But the like evidence further testifies that the formation of most other aneurisms, and the progress of all, are of a slow or chronic character. Still, it would seem to be difficult if not impossible to determine the duration of the disease in any given instance, inasmuch as many cases, for example, have been found in the *post-mortem* room, which had not given rise to any special symptoms; whilst in other cases the pre-existence of heart-disease before the formation of aneurism rendered it equally impossible to fix a date for the development of the latter special disease.

Death may result from the disturbance of the heart's action, induced by the presence and extent of the disease; from the aneurism opening into the pericardium; or from its burrowing in the wall of the heart, and opening into another cavity of the organ different from that in which it originated. Lastly, one or two cases are recorded in

which a cure of the disease had apparently been effected by the walls of the sac becoming indurated or calcified.

Diagnosis and Prognosis.—Seeing how extremely obscure the clinical history of these cases is, it would be impossible to speak more definitely either as to the diagnosis or the prognosis of the disease than has been done under the preceding head.

Treatment.—The treatment of cardiac aneurism must be such as would be adopted in any other form of grave heart-disease, and according to the circumstances of each case. We can only seek to mitigate the more urgent symptoms, whether local in the heart itself, or more generally affecting the distant organs.

R. Quain, M.D.

HEART, Apoplexy of. *See* Heart, Hæmorrhage into Walls of.

HEART, Atrophy of.—Definition.—A diminution in the size and weight of the heart as a whole; or a diminution in size of one part of the heart in relation to the whole organ.

Ætiology.—The causes of atrophy of the heart are either *general* or *local*. With respect to the *general* causes of atrophy, the heart is found reduced in volume together with the other organs of the body, in cases of marasmus, of phthisis, of syphilis, cancer, &c. Probably one of the smallest hearts on record—one which weighed but $3\frac{1}{16}$ ounces—was found by Dr. Church in the body of a woman aged forty-seven, who died of cancer of the pylorus, after an illness characterised by 'gradual starvation' of more than seventeen months' duration. With reference more especially to phthisis, as affecting the size of the heart, an analysis of 171 cases made by the writer at the Brompton Hospital, showed that this organ was below the average weight in 54·4 per cent. Diseases of a subacute character, such as typhoid fever when protracted in its course, may lead likewise to wasting of the heart. The heart is also occasionally congenitally small.

The *local* causes of atrophy of the heart are chiefly two, namely (1), pressure by pericardial adhesions upon the heart in certain cases of generally impaired health, by mediastinal tumours, by fatty growth beneath the pericardium, and other conditions; and (2) interference with the circulation in the coronary arteries, as in the conditions just enumerated, or as a result of malformation or of disease of the vessels themselves.

Partial atrophy of the heart, when it occurs, is generally referable to insufficient blood-supply from vascular disease or local pressure; or to fatty infiltration.

Anatomical Characters.—The heart in simple atrophy presents a general uniform diminution in size, as regards both its walls and its cavities; and in its weight. In local atrophy, a portion of the cardiac wall, more or less extensive, or of one of the divisions or cavities of the heart, may be found to be below the ordinary dimensions. The colour of the atrophied heart may be normal; it is frequently pale; and it is occasionally of a deep reddish-brown. The pericardium, not shrinking proportionately with the muscular substance, may present a puckered, opaque, and œdematous aspect, 'like a withered apple' (Laennec); and for the same reason the coronary vessels may be tortuous and prominent. The consistence of the walls is generally firmer than natural; and the muscle may be even tougher, except where the atrophy is due to the presence of fat, in which case the fibres are friable, and on microscopical examination present the appearances of fatty degeneration. In *simple* atrophy of the heart, the muscular fibres undergo diminution in volume; and they may also be actually reduced in number. Atrophy of individual muscular fibres is also found as the result of interstitial fatty or fibroid growth; and this when extensive has been somewhat erroneously named '*yellow* atrophy.' Another variety, which is most frequently found in the marasmus of old age, is known as *brown* atrophy of the heart. In such cases the muscular tissue is of a dark or dirty reddish-brown colour, which proves on microscopical examination to be due to the presence of numerous shining yellow or brown pigment-particles within the muscular fibres, and specially abundant either around the nuclei or between the ultimate fibrillæ.

Symptoms.—The symptoms and signs of atrophy of the heart are those which might be expected to result from diminished size and power of that organ. The characteristic phenomena are those of feeble circulation. The physical signs are chiefly diminished præcordial dulness; a feeble impulse, the apex-beat being within and above the usual situation; diminished area of audible sounds; and a small, weak pulse.

Diagnosis.—The above signs and symptoms, in association with general wasting, afford sufficient grounds for the diagnosis of atrophied and feeble heart. Emphysema, pericardial effusion, and other causes of diminished cardiac dulness and weakness of impulse, must be excluded by the ordinary modes of investigation. There are no special means by which *partial* atrophy of the heart can be diagnosed, except, possibly, that the presence of this condition may be assumed where the functions of the organ are disturbed in the absence of valvular or other of the more common forms of cardiac disease, sufficient to explain the symptoms.

Treatment.—The treatment of atrophy of the heart is the treatment of the primary disease upon which it depends, so far as is possible.

R. Quain, M.D.

HEART, Calcification of. *See* Heart, Degenerations of.

HEART, Cancer of. *See* Heart, Morbid Growths in.

HEART, Cirrhosis of. *See* Heart, Fibroid Disease of.

HEART, Congenital Misplacement of.—Synon.: *Ectopia Cordis* (Breschet), *Ectocardia* (Alvarenga).

The heart is occasionally found to occupy a wrong position, and such misplacement may either be within the cavity of the thorax, or external to it.

1. Of the *internal* malpositions—*ectopia cordis*

intrathoracica or *ectocardia intrathoracica*—the most common is that to which the term *dexiocardia* has been applied, in which the heart is in a very similar position on the right side of the chest to that which it should occupy on the left. This condition may coexist with transposition of the other viscera of the body, or it may occur alone. Instances of the former kind have long been placed on record, cases having been met with in Rome in 1643, in Paris in 1650, and in London in 1694. When the heart is misplaced, the aorta generally follows an irregular course, crossing the right bronchus and passing down to the right side of the bodies of the vertebræ; and the right carotid and subclavian arteries are given off as separate vessels, while the brachio-cephalic trunk is situated on the left side. In some instances, however, the vessels at the arch are not transposed; whilst in others the aorta, after passing over the right bronchus, crosses the spine and follows its usual course to the left of the bodies of the vertebræ. In cases of transposition the heart itself may be well-formed; or it may be very imperfectly developed.

In another kind of misplacement, *mesocardia*, the heart is situated more in the median line than natural—a position which it occupies in the fœtus at the earlier periods. Cases have also been recorded in which the organ occupied a transverse, and an antero-posterior direction.

2. Of the *external* misplacements, those in which the heart is situated external to the thoracic cavity—*ectopia* or *ectocardia extrathoracica*—the most common is that in which, from deficiency of some part of the sternum, the organ lies in front of the chest—*ectopia cordis* or *ectocardia pectoralis*. In other cases, from deficiency in some portion of the diaphragm, the heart is placed in the abdomen, either lying in the cavity, or, if the integuments are partially defective, in a sac in the præcordia—*ectopia cordis* or *ectocardia abdominalis*. In a third form the heart lies at the root of the neck—*ectopia cordis* or *ectocardia cephalica*. Of these forms, examples are related or referred to in the memoirs of Breschet and Alvarenga, and various others have been published since the appearance of the memoir of Breschet.

Symptoms, Duration, and Terminations.—When the heart is well-formed, its malposition within the thorax does not necessarily cause such interference with its functions as to be productive of symptoms, or materially to curtail the duration of life. Indeed, cases are on record in which the heart and other viscera have been transposed in persons who had never presented any signs of disorder of the circulation, and who lived to very advanced ages. When, however, the organ is also defective, and especially when the displacement is external to the thoracic cavity, life is usually only of short duration—though some remarkable cases of external displacements are on record, in which the patients survived to advanced ages.

Malformation of the Pericardium.—Closely allied to the cases of misplacement of the heart are those in which the organ, though occupying its natural position, is not covered by the pericardium, but lies in contact with the lung in the left pleural cavity. Of this form of anomaly various instances are recorded—the first undoubted case of the kind being probably that represented by Dr. Baillie, in 1778. The defect seems to consist in the pericardium, which is apparently reflected from the external coat of the aorta, not being prolonged so as to cover the front of the heart and become attached to the diaphragm. The imperfectly developed membrane is represented by a kind of loose fold, or pocket, which is found on the right side or upper part of the heart.

Effects.—This condition does not seem materially to interfere with the functions of the organ. Cases are recorded in which the subjects lived to middle age; and the writer has himself seen it in a man who died of heart-disease at seventy-five. T. B. Peacock.

HEART, Congestion of.—Attention was first directed to this morbid condition of the heart by Sir William Jenner (*Medico-Chirurgical Transactions*, vol. xliii. p. 199). The coronary veins, like the veins of other parts, are subject to engorgement, when the flow of the blood from them into the right auricle is interrupted. The most common cause of this is dilatation and distension of the cavities of the right side of the heart, which conditions are themselves usually due either to emphysema or to valvular disease of the heart. Disease of, or pressure on, the trunks of the coronary veins may be regarded as less frequent causes of the same result.

Anatomical Characters.—Congestion of the heart is recognised, when recent, by the fulness of the veins on the surface of the organ; œdema of the loose connective tissue at the base; and ecchymosis of the pericardium and endocardium. The pericardial sac contains some serous or sero-sanguinolent effusion; and the mouth of the coronary sinus may be found to be dilated. When the congestion is slight, gradually developed, and of long standing, the venous fulness gives rise to an increased formation of connective tissue in the walls of the heart, which become, in consequence, tough and indurated; whilst the dilatation of the cavities, with which the congestion is associated, is rendered permanent by the same cause. When divided with the knife, the cardiac walls do not fall inwards; their substance feels like a piece of leather; and the section has a smooth homogeneous appearance. Microscopically, the connective tissue seems to be increased in quantity; and the muscular fibres are in a condition of granular, fatty, and pigmentary degeneration.

Congestion of the heart possesses no direct clinical relations. J. Mitchell Bruce.

HEART, Connective-Tissue Hypertrophy of.—Definition.—An excessive development of the connective tissue which exists between the muscular fibres of the heart, causing an increase of the volume of the organ.

Anatomical Characters.—In connective-tissue hypertrophy the heart is enlarged more or less uniformly as regards the walls of its several cavities, and usually greatly, weighing in some instances as much as forty ounces. The thickness of the walls is increased, as in simple hypertrophy; and their density and

consistence are such that they present a firm, tough, leathery character. When cut the edges do not collapse, but continue stiff and prominent. The colour of a heart in this condition may vary from pale buff to deep purple, according to the amount of connective tissue and of blood present in the vessels. Microscopically there is seen —not the usual limited amount of intermuscular fibrillar tissue and connective-tissue cells, but a decided hyperplasia of these elements, in the form of connective tissue, of which all stages of development may sometimes be observed, from the round and spindle-shaped cell to the perfect bundle of fibrillæ. Between the individual bundles of connective tissue lie the muscular fibres, which are also hypertrophied, but which are more or less compressed, and are occasionally in a condition of granular or fatty degeneration.

There is a certain amount of anatomical resemblance, but a very clear pathological distinction between this form of heart-disease and the change described by Sir William Jenner as fibroid disease of the heart resulting from congestion (*see* HEART, Congestion of). Connective-tissue hypertrophy may also to some extent be compared with the fibrosis described by Sir William Gull and Dr. Sutton as existing in the walls of arteries and other tissues.

ÆTIOLOGY.—Cases of hypertrophy of the heart have been described by several writers in which there was disease neither of the valves, vessels, nor kidneys to account for it, and which the writer believes to be due to the pathological changes here described. A remarkable specimen is preserved in the museum of St. George's Hospital, consisting of a heart weighing forty and a half ounces, which was removed from the body of an under-butler, in the post-mortem examination of whom nothing was found which could satisfactorily explain the occurrence of the enlargement. The writer is indebted to Dr. Whipham for an opportunity of examining this specimen, which was found by his friend, Dr. Mitchell Bruce, to possess the microscopical characters above referred to. This and similar cases exhibit no appearance of chronic inflammatory action, and thus differ altogether from examples of that form of fibroid degeneration which is described under a separate heading (*see* HEART, Fibroid Disease of). In the cases now described there is a simple hyperplasia of connective tissue, the origin of which cannot be fully explained. In Germany similar enlargement of the heart is said to have been more especially found in gourmands, and hence it derived a characteristic appellation. The existence of connective-tissue growth being thus determined, the effect of its presence on the muscular tissue is obvious. The connective tissue, surrounding, as it must do, the muscular fibres, interferes with their free action, to overcome which there will be a natural tendency to increased action, and consequent hypertrophy of the muscular fibres themselves. It is very probable that it is to these two processes going on simultaneously that the great increase in the size of the heart is due.

SYMPTOMS AND DIAGNOSIS.—In a remarkable case recorded by the late Dr. Hyde Salter, which the writer believes to have been of the nature here described, acute or severe cardiac dyspnœa and hæmoptysis, from which the patient had suffered for several weeks, were the most prominent symptoms. The heart-sounds were natural, except that the first was dull and defective. The pulse was 84. The symptoms increased in severity, and were aggravated by excessive epistaxis. The patient died after being in hospital for fourteen days. At the *post-mortem* examination the heart was found to be of great size, and there was no disease either of the valves or of the vessels or of the kidneys to account for it. In the case of the butler in St. George's Hospital, it is recorded that he continued going about until within a few days of his death. These and some like cases indicate that we can do little in the way of diagnosis beyond recognising the presence of cardiac hypertrophy by the usual signs; and if the hypertrophy be considerable, and if there be no valvular disease and no kidney-disease, we might not be far wrong in considering that the hypertrophy was caused by increase of some other element than that of the muscular fibres.

TREATMENT.—If the opinion be correct that this form of disease finds its origin in excessive alimentation, it would be well to place the patient in such circumstances as would prevent this, giving attention at the same time to other hygienic conditions. The more aggravated symptoms of cardiac disease must be treated on general principles. R. QUAIN, M.D.

HEART, Coverings of, Diseases of. *See* PERICARDIUM, Diseases of.

HEART, Degenerations of.—The degenerations that affect the heart may be enumerated as follows:—1. Fatty; 2. Parenchymatous; 3. Albuminoid; 4. Pigmentary; 5. Cartilaginous; 6. Calcareous; and 7. Vitreous. The condition which has been called 'fibroid degeneration' of the heart is described under the heads of HEART, Fibroid Disease of; and HEART, Syphilitic Disease of.

1. **Fatty.**—This form of degeneration of the heart being of special importance is discussed in a separate article. *See* HEART, Fatty Degeneration of.

2. **Parenchymatous.**—SYNON.: Granular degeneration; Cloudy Swelling; ? Parenchymatous inflammation.

ÆTIOLOGY.—This form of degeneration of the heart is generally met with in the acute specific fevers, especially typhus, typhoid fever, diphtheria, and septicæmia; and is probably referable to the action either of the poison or of the high temperature attending the disease-process upon the muscular substance.

ANATOMICAL CHARACTERS.—The disease generally attacks the heart as a whole. The organ appears somewhat enlarged, extremely soft—flabby as well as friable, and of a dirty grayish-red colour. The pericardium is ecchymosed, dull, and swollen, and the epicardial fat has more or less completely disappeared. Microscopically, the muscular fibres are found to be dull and granular, swollen, and variously ruptured; their

striations are indistinct; and the addition of acetic acid removes many of the granules from the fibres, whilst it brings more distinctly into view a few fatty globules, and frequently an increased number of pigment-particles.

Symptoms.—Inasmuch as parenchymatous degeneration of the heart is usually but a complication of some acute specific disease, the condition of the patient is one of great febrile prostration with cardiac asthenia. The physical signs, which are regarded as more distinct evidence than the symptoms of the condition of the heart, are —feebleness, advancing to complete absence, of the apex-impulse, or more rarely palpitation; and progressive weakening, and finally loss of the first sound. The pulse has been described as corresponding with the condition of the heart, except in some cases where it is imperceptible, although associated with cardiac palpitation.

Course and Terminations.—The course and terminations of granular degeneration of the heart are inseparable from those of the primary disease. In typhus the average date of the appearance of the symptoms and signs just described is the sixth day of the fever, and they usually cease on the fourteenth day. A large proportion of cases prove fatal at or before that time.

Prognosis.—The existence of this kind of degeneration of the heart adds seriously to the gravity of a case of fever; and the danger increases with the rate and weakness of the pulse, and the feebleness of the cardiac impulse and first sound. The return of the latter under treatment justifies a favourable prognosis.

Treatment.—The treatment of parenchymatous degeneration of the heart is in no respect different from that of the fever in which this condition originates. The appearance of the characteristic symptoms and signs of the cardiac affection is, however, to be regarded as an important indication for the use of alcoholic stimulants, which are, as a rule, well borne in such cases, and act very beneficially.

3. **Albuminoid.**—This kind of degeneration has been said, with a certain amount of possibility, to have been found in the heart. It is certainly excessively rare.

4. **Pigmentary.**—Pigment-granules, in the form of shining yellow particles, are almost invariably found in the muscular fibres of the heart in chronic cardiac disease. In certain cases of atrophy known as 'brown atrophy,' as well as in the granular degeneration just described, these pigment-particles are decidedly increased in number, and collected towards the axis of the fibres. A somewhat similar appearance is seen in the heart in jaundice.

The condition is of purely pathological interest.

5. **Cartilaginous.**—Portions of the myocardium have frequently been described as 'cartilaginous' or 'fibro-cartilaginous,' but it would appear that in these instances the muscular tissue was replaced by dense firm fibroid tissue only. *See* Heart, Fibroid Disease of.

6. **Calcareous.**—Calcification of pericardial adhesions is not very rare; and in some of the recorded instances of this condition, plates of the same material have been found projecting into the substance of the heart, appearing as if formed within the myocardium. Besides this class of cases, instances of true deposit of calcareous particles within the individual muscular fibres have been described. This appears in the form of small, pale, gritty deposits, taking the place of the normal muscular tissue on the surface, in which, on microscopical examination, the muscular fibres were found to have become solid and opaque, whilst hydrochloric acid or sulphuric acid removed the opacity with the evolution of gas, the addition of the latter acid also producing gypsum crystals. It is probable that in other recorded instances, the calcareous particles were situated outside the muscular fibres, and may have been the products of a caseous nodule, whether syphilitic or 'tubercular' in origin.

This form of disease appears to possess no special clinical relations.

7. **Vitreous.**—Vitreous, waxy, or colloid degeneration, as described by Zenker, occurs in the myocardium, as it does in the voluntary muscles. J. Mitchell Bruce.

HEART, Dilatation of.—Definition.—Dilatation of the heart may occur in two forms. in the one it involves only a limited portion of the cardiac walls and constitutes an aneurism; in the other there is uniform enlargement of one or more of the heart's cavities, and dilatation in the usual acceptation of the word is present. To this latter condition, however, the names 'aneurism' and 'passive aneurism' of the heart were formerly applied. Dilatation is probably always associated with hypertrophy.

Ætiology.—The occurrence of dilatation implies that the walls of the heart which yield, are too weak to resist successfully the internal pressure to which they are exposed. This defective relation may be due either to actual enfeeblement of the heart's walls, which renders them unequal to the task normally devolving on them; or to excessive blood-pressure, which even the healthily-constituted walls are unable to withstand. The enfeeblement of the heart may be a consequence of fatty or other degeneration; or, as is probably more frequently the case, may be inherent but unconnected with visible textural disease. The excessive blood-pressure may be dependent on actual obstruction to the circulation which the heart is called upon to surmount: or on undue rapidity of action which (other things being equal) implies an unwonted expenditure of force. As a matter of fact, however, dilatation and hypertrophy are generally if not always associated; and the processes by which these combined conditions are attained are more complicated than the foregoing statement might lead one to suppose. It will be convenient, therefore, to consider certain cases *seriatim*.

1. In obstructive disease at the aortic orifice; in general stricture of the minute systemic arteries, such as occurs in connection with contracted granular kidneys; and indeed in all cases in which resistance is offered to the free discharge of blood from the left ventricle, progressive hypertrophy of the walls of that ventricle takes place. But the hypertrophy is complicated even from the beginning with dilata-

tion. The hypertrophy, at any rate at first, is simply compensatory, and may be taken as a measure of the excess of resistance which the heart is called upon to overcome. The dilatation, however, is in no sense compensatory, and is probably to be regarded as a measure of the inability of the walls to cope successfully with the extra work required of them. It is, moreover, obvious that the occurrence of dilatation, by increasing the area of resistance to the endo-ventricular blood-pressure, increases *pro tanto* the muscular effort requisite for the propulsion of the blood into the aorta; and by enlarging the capacity of the ventricular cavity and consequently the amount of blood to be discharged from it, on that account also throws additional labour on the muscular walls of the ventricle. Thus the hypertrophy and dilatation react on one another; and the hypertrophy, which was probably at first simply compensatory of the mechanical obstacle to the discharge of the normal contents of the ventricle, ends by becoming —or rather striving to become—compensatory not only of this but of the virtual weakness of the heart which dilatation entails.

2. In regurgitant disease at the aortic orifice, hypertrophy and dilatation of the left ventricle also take place. But in this case, while the hypertrophy probably reaches a higher degree of development than in simple obstruction, dilatation preponderates from first to last; and the ventricle attains larger dimensions than in perhaps any other form of disease. But to what are the hypertrophy and dilatation due in this case? There is no impediment to the escape of blood through the aortic orifice, and therefore *primâ facie* no need for compensative hypertrophy. There is no doubt that here hypertrophy waits on dilatation. The first effect of regurgitation is, that during diastole the ventricle becomes more rapidly and completely filled with blood than it does under other circumstances, and that the subsequent contraction of the auricle tends to distend it unnaturally with blood. The result is that, on the principles above enunciated, the walls of the ventricle have to encounter a larger area of pressure, and to expel a larger amount of blood than natural, and hence are called upon to make excessive effort, and hypertrophy ensues. Thus the tendency to dilatation causes the tendency to hypertrophy; and both acting continuously promote the progressive increase in the capacity of the ventricular cavity, and in the thickness of the ventricular walls.

It is probable in both cases, but more especially in the latter of them, that ere long the ventricle fails to expel the whole of its contents into the aorta at each contraction, and that the retention of this residual blood becomes an important factor in promoting dilatation.

3. The effects of continued violent action of the heart, whether caused by nervous influence or by muscular effort are much the same as those of obstructive disease. For both increased rapidity of contraction, and increased amount of blood to be expelled at each beat, other things being equal, imply increased expenditure of force; and the persistence of either or both of these conditions, therefore, the supervention of hypertrophy and dilatation.

4. The above discussion relates especially to dilatation and hypertrophy of the left ventricle. But, *mutatis mutandis*, it applies with equal force to dilatation and hypertrophy of the other sections of the heart. Thus, in mitral valve disease, the left auricle undergoes hypertrophy and dilatation—the dilatation preponderating in regurgitant disease of the valve, the hypertrophy preponderating in obstructive disease.

5. In pulmonic valve disease the right ventricle becomes hypertrophied and dilated—the dilatation being greatest where there is pulmonic regurgitation, the hypertrophy being greatest where the disease is obstructive.

6. In tricuspid valve disease the right auricle suffers, becoming chiefly dilated in the presence of tricuspid regurgitation, chiefly hypertrophied when there is obstruction. And thus, also, just as when the systemic circulation is impeded the left side of the heart suffers, so when the pulmonic circulation is obstructed, the right side of the heart undergoes enlargement.

In all cases, therefore, hypertrophy and dilatation seem to result concurrently; but whether the one or the other condition preponderates, depends partly on the particular nature of the cause to which the hypertrophy and dilatation are due, partly on the inherent strength or weakness of the cardiac walls. In all cases, too, the other cavities of the heart, besides that primarily and directly implicated, suffer according to their position from the effects of the greater or less work which sooner or later is cast upon them.

The temporary dilatation which is described as occurring in acute febrile disorders, such as typhus, is due mainly to enfeeblement of the cardiac walls.

Anatomical Characters.—In dilatation of the heart, the cardiac walls may be either thinner or thicker than natural, or may retain their normal thickness. It is a question, however, whether, excepting in the case of partial dilatation or aneurism, dilatation ever takes place independently of hypertrophy; for even as regards the auricles, where dilatation with attenuation is chiefly observed, there is reason to believe that the attenuation is not commensurate with the extension which accompanies it, and consequently that the total bulk of muscular tissue is increased. When dilatation is associated with no apparent change in the thickness of the walls, hypertrophy is of course present.

It must be mentioned, however, that it is often very difficult to determine on *post-mortem* examination the true relation between the thickness of the cardiac walls and the capacity of the cardiac cavities. For their apparent relation is largely dependent on the condition of the cavities at the moment of death, as to systole or diastole; and on the state of the heart as to cadaveric changes at the time of *post-mortem* examination.

The form which the heart assumes in dilatation is the same as that which it assumes in hypertrophy, and indeed as the two conditions are probably always associated, it is needless to endeavour to establish any distinction between them in this respect. If the dilatation be general, the form of the heart remains unchanged, but its size is uniformly augmented.

If the left ventricle be mainly affected, the heart appears not only enlarged but elongated, the left ventricle taking more than its due share in the formation of the cardiac apex. If the right ventricle be specially implicated, the heart becomes enlarged in its transverse diameter; it is more rounded in its contour as seen from the front than it should be; and its apex is obtuse, and either bifid, from the fact that the apices of both ventricles take an equal share in the formation of the cardiac apex, or formed wholly by the right ventricle. If the auricles be dilated, they constitute large masses on both sides of the root of the aorta and pulmonary artery.

The walls of the dilated heart vary not only in thickness but also in quality. Thus they may be preternaturally firm or preternaturally soft; they may be healthy in structure, or may present more or less degenerative change.

Consequences of Dilatation.—Dilatation of the ventricles, especially if it be considerable, is apt to disarrange the mechanism of the auriculo-ventricular valves. It was shown many years ago by Mr. Wilkinson King that even in mere temporary distension of the right ventricle a kind of safety-valve action of the tricuspid valve took place, in consequence of which regurgitation of blood was permitted from the ventricle into the auricle. And since his time it has been clearly demonstrated, both by clinical and by *post-mortem* evidence, that established dilatation of the right or left ventricle is liable to be attended with persistent regurgitation of blood through the corresponding auriculo-ventricular orifice. The defaulting valve under these circumstances has a natural aspect; but careful examination shows either that the orifice has undergone dilatation in company with the ventricle—the valve itself presenting no corresponding increase, or that there is a want of relation between the size of the musculi papillares and chordæ tendineæ on the one hand, and the capacity of the ventricle on the other, which interferes with the due closure of the valve.

It is obvious that if regurgitation becomes established, the usual consequences of regurgitation will presently ensue; namely, in connection with affection of the left side of the heart, dilatation and hypertrophy of the left auricle, and subsequently congestion of the lungs and pulmonary apoplexy; and in connection with affection of the right side of the heart dilatation and hypertrophy of the right auricle, fulness of the systemic veins, anasarca, nutmeg liver, and congested, indurated kidneys. It is also obvious that, even if no regurgitant condition be developed, dilatation of heart, which implies feebleness of heart and imperfect circulation, must ultimately induce the ordinary remote consequences of heart-disease. A further consequence of dilatation and other cardiac affections attended with feeble circulation is the formation of thrombi during life, both in the heart itself, and in other parts of the vascular system. Mr. Wilkinson King has demonstrated that dilatation of the left auricle may cause compression of the left bronchus.

Symptoms.—Since dilatation of the heart rarely if ever exists alone, but is associated with hypertrophy, valve-disease, degenerations, and other conditions, it is almost impossible to make any definite statement with regard to the signs and symptoms by which its presence may be recognised. Still there is no doubt that dilatation is one of the most important factors of heart-disease, clinically considered; and that its supervention materially affects the patient's condition, and prospect of life. Dilatation implies weakness, and as a rule over-distension of the implicated cavities with blood, which probably never becomes wholly expelled.

The *physical signs* of dilatation are necessarily in many respects the same as those of hypertrophy. The præcordial dulness is increased in area—the extent and form of this area, and the situation of the apex-beat, being determined by the general size of the heart, and the relative dimensions of its component parts. In proportion, however, as dilatation preponderates over hypertrophy, the impulse of the heart becomes weak, and possibly to some extent diffused. In extreme dilatation, as in extreme weakness from other causes, the sounds of the heart, and especially the first sound, are enfeebled. And it may be asserted that generally the tendency of dilatation is to shorten the first sound, and to give it the characters of the second sound. It has nevertheless been observed over and over again that it is in the concurrence of hypertrophy and dilatation that the cardiac sounds are apt to attain their greatest intensity. The feebleness of the heart's action is generally attended before long by more or less irregularity; and even in the absence of valve-disease, a mitral or tricuspid systolic murmur, implying regurgitation, is apt to be established.

The symptoms of dilatation are to a large extent those of cardiac obstruction, and more especially of mitral disease. The patient complains of weight, oppression or uneasiness in the cardiac region, with probably a sense of fluttering there, and of a tendency to sighing respiration. He becomes short-breathed, and may have extreme dyspnœa. His face is apt to become livid; his surface pale or ghastly; his extremities cold and blue; and his pulse weak and irregular. Dilatation of the systemic veins arises sooner or later; and subsequently general anasarca, pulsation of the veins in the neck, epigastric pulsation, and pulsation of the liver, together with the other usual consequences of heart-disease. The chief of these are—congestion of the lungs, with pulmonary apoplexy, cough, and expectoration of blood; congestion, enlargement, and tenderness of the liver, with jaundice; and congestion of the kidneys, attended with the discharge of scanty, high-coloured, heavy urine, containing albumen and possibly blood. Other symptoms referable to the nervous and digestive organs, which need not be enumerated, are also liable to supervene.

The symptoms will vary, of course, according as the left or the right ventricle is mainly affected. In the former case we are liable to have at first irregularity and feebleness of pulse with tendency to faint; then pulmonary complications; and at a later period, symptoms referable to the systemic venous circulation. The latter case is one of considerable interest; because in a large number of instances it is, in its most marked form, a consequence of emphysema of the lungs, or of

other analogous conditions, and moreover is apt to come on very rapidly. Under these circumstances, there is necessarily much dyspnœa, but the systemic venous and capillary systems speedily become over-loaded; extreme cyanosis often develops rapidly; and, before long, all the other symptoms referable to disease of the right side of the heart become established: namely, pulsation of the veins in the neck, epigastric pulsation, pulsation of the liver, general anasarca, with perhaps petechial extravasations, jaundice from nutmeg liver, and albuminuria from congestion of the kidneys.

Prognosis.—There is no doubt that some degree of dilatation of the heart, and more especially of the right ventricle, may arise, either from over-exertion, or from functional disturbances, and in connection with pulmonary disorders. But such dilatation is for the most part temporary or remediable; and only by continuance of its cause becomes established and a matter of serious importance. In the same way there is no doubt that the dilatation which comes on in the course of organic disease of the heart or lungs, or of other organic diseases which influence the action of the heart, is remediable within certain limits by due attention to the conditions under which it arises. Nevertheless it is certain that the presence of dilatation of the heart in connection with other diseases, more especially those of the heart, lungs, or kidneys, is a grave source of danger; and that in the great majority of cases it is of fatal omen, aggravating the patient's cardiac symptoms, and hastening his death.

Treatment.—The treatment of dilatation of the heart merges in that of the other cardiac conditions with which it is associated, and in that of other diseases in the course of which it may have supervened. It may be stated, generally, however, that the treatment is that of cardiac debility, and of distension of the heart with blood.

The chief indications, therefore, are rest of mind and body; avoidance of exposure to cold and wet; the exhibition of ample nutritious and readily digestible food; due attention to the action of the bowels, kidneys, and skin; and the employment of medicines likely to regulate and strengthen the action of the heart. For the last purpose digitalis in small doses is universally acknowledged to be of great value. And it is in most cases desirable to combine the digitalis with iron, or some vegetable tonic. Ammonia and other diffusible stimulants are often called for, and are of great service. In cases where there is much lividity, and evidence of stagnation of blood in the right side of the heart, removal of blood by venesection may be of use.

When the dilatation is due to pulmonary disease, this of course requires primary and especial treatment. J. S. Bristowe.

HEART, Displacements of.—Besides the displacements of the heart that occur as the result of disease, there are certain changes of position which this organ undergoes in health. The most important of these physiological displacements of the heart are—first, its vertical movements in respiration; and, secondly, the alterations in its situation corresponding with changes in the bodily posture. The present article, however, will deal only with the former class, or abnormal displacements of the heart.

Ætiology.—The heart may be congenitally displaced—a condition which is described under the head of Heart, Congenital Misplacement of. These cases being excepted, the causes of displacement of the heart may be arranged in two classes—namely, (1) conditions that exert *pressure*; and (2) conditions that exercise *traction* upon the heart.

(1) The heart is *pressed* or pushed out of position by effusions of fluid—inflammatory, serous, or bloody—into either pleural cavity; by pneumothorax of either side; by intrathoracic tumours—whether mediastinal (including aneurism and abscess), pulmonary, or parietal; by hypertrophous emphysema, or other causes of enlargement of the lungs; by extensive pneumonic consolidation; or by abundant pericardial effusion of any kind. Certain conditions of the abdominal contents produce a similar effect, for example—gaseous distension of the stomach and intestines; enlargement of the liver and other solid organs; abdominal tumours of all kinds; the pregnant uterus; and ascites, when considerable. Hernia of the abdominal viscera through the diaphragm, and abscesses connected with the diaphragm, also cause displacement of the heart.

(2) The heart suffers *traction*, or is drawn out of position during absorption of pleuritic effusion with imperfect expansion of the lung, on either side; by the contraction of pleuro-pericardial adhesions, of pulmonary cirrhosis, or of cavities in phthisis; in collapse of either lung from pressure on the main bronchus; and in some forms of deformity of the chest from curvature of the spine.

Mechanism of Displacement.—The causes just enumerated constitute in each instance what may be called the *displacing force*. When this force belongs to the first or *pressure* class, it acts against the surface of the pericardium and heart that is opposed to it, and presses or pushes it, *a tergo*, away from its own seat, in the direction of least resistance. Thus the heart is, speaking broadly, pushed towards the left by effusion into the right pleural cavity; towards the right by similar disease on the left side; downwards by tumours in the region of the base; and upwards by gaseous distension of the stomach.

On the other hand, when the displacing force is of the nature of *traction*, the heart is drawn *a fronte*, that is, towards the seat of the force. Thus, when a cavity in a phthisical lung is contracting, the pericardium and heart, as well as the walls of the chest, are displaced towards the healing area. It must be observed, however, that in this class of cases, actual traction, in the strict sense, is rare, and that the displacing force is, in reality, the atmospheric pressure; the heart and the other organs being 'sucked' towards the potential vacuum, in the same way as water is 'drawn' into a syringe. Still, in a very small number of cases, the pericardium does actually become involved in a healing pro-

cess in the lungs; and it and the heart are dragged towards the cicatrix.

Besides the displacing force, there are at work in dislocation of the heart certain other agencies, which contribute to the result, whether their effect be to increase or to diminish that of the chief cause.

a. The weight of the heart manifestly favours displacement in different directions, according to the posture. Thus, in the erect posture, it favours downward, and limits upward displacement. However, the weight of the heart is comparatively insignificant, and may be practically disregarded.

b. The resistance, positive or negative, of neighbouring parts must be taken into account. The heart when disturbed from its position will move in the direction of least resistance. Thus it cannot be displaced to any extent either forwards or backwards; but is moved with comparative ease towards either pleural cavity. The resistance inferiorly is greater under the right half of the diaphragm than under the left. On the other hand, the resistance around may become negative; for example, in left pleural effusion the corresponding half of the diaphragm is pushed downwards, and the accompanying downward displacement of the cardiac apex is thus increased.

c. The heart is attached at its root; and, speaking broadly, this is a fixed point, at the right and upper extremity of the long cardiac axis. This attachment will limit and otherwise modify displacements of the heart in all directions, especially downwards. Round this point as a centre, and with the long axis as the radius, the apex of the heart will describe an arc of a circle, cutting the surface of the chest in the left axilla, the left submammary region, the epigastrium, the right submammary region, and the right axilla.

d. The tendency that the heart has to rotate or roll on one or other of its axes is also affected by its attachment at the root. If the heart lay free in the pericardial cavity, there would be no limit to such rotation under the influence of pressure or of traction. The base being fixed, rotation is greatly limited, and does not occur to any extent except around the longitudinal axis; the left ventricle, for example, being rotated more forwards or more backwards, as the case may be. Rotation round the transverse-horizontal and the antero-posterior-horizontal axes is very limited.

Anatomical Characters and Effects.—The only essential change that the heart is found to have undergone in displacement is an alteration of its relations to the surrounding parts. The softer parts of the cardiac wall, however, such as the auricles, are sometimes compressed to a moderate degree. The pericardium is partly dislocated and partly stretched. The great vessels at the base of the heart and at the root of the neck may be elongated, shortened, twisted, or bent, according to the particular form of displacement; and the circulation within them impeded. The neighbouring organs are variously displaced and compressed. One of the effects often seen after displacement is permanent fixation of the pericardium and heart in their new position, for example, in the pleural cavity, on the disappearance of the original cause.

The effects of displacement of the heart upon its functions differ greatly in the two classes of dislocation to which we have referred:—

In displacement due to *pressure*, the heart is compressed between the displacing force and the resistance in other directions, and the dislocation is generally rapid. Fortunately, in most cases of such displacement the resistance is slight; and the heart, if healthy, suffers little or no real compression of its substance or cavities between the two forces, the mobile and compressible lung especially yielding before it. But if the heart be diseased—and especially if its walls be weak, degenerated, or dilated—moderate compression may cause embarrassment of the cardiac action and even fatal paralysis; and the rapidity or even suddenness with which displacement generally occurs when due to pressure—for example, in pneumothorax, is another and perhaps the principal cause of this embarrassment.

On the other hand, when the heart is *drawn* out of its normal situation towards a phthisical cavity, or towards either pleural cavity from which an inflammatory effusion is being absorbed, the displacement occurs, not because there is want of space, but because there is excess of space within the thorax. The process is also very gradual. The effects, therefore, upon the functional activity of the heart may be said to be few, though the unusual pulsation may be a source of inconvenience, and even of anxiety to the patient. In very rare cases, the heart and pericardium when thus displaced, may be involved in the fibrotic process going on in the lung or pleura, and the adhesions thus established may ultimately interfere with the cardiac action.

Symptoms.—In displacement of the heart, special symptoms are frequently slight or altogether wanting; or they are inseparable from the symptoms of the original cause. This may be said to be almost invariably the case when the displacement is due to gradual traction, as in phthisis. In the pressure class of cases, on the contrary, there are frequently developed, and that rapidly or suddenly, symptoms due to compression of the heart, such as a sense of distress, stifling, and pain over the præcordium or at the epigastrium, or even true angina; dyspnœa, perhaps amounting to orthopnœa; palpitation; blueness of the surface; and irregularity and feebleness of the pulse. When the displacement is due to upward pressure from gaseous distension of the stomach and intestines, the above symptoms may be associated with flatulence or 'spasms,' and are relieved by the erect posture, eructation, vomiting, and the administration of carminative and absorbent remedies. If this condition be not removed within a short time, it may become aggravated, pass into a state of collapse, and end in death.

Varieties and Physical Signs.—The varieties of cardiac displacement, according to the direction in which the dislocation occurs, may, for clinical purposes, be said to be as follows:—towards the *left*, towards the *right*, *downwards*, *upwards*, *backwards*, and *forwards*. It must be observed, however, that this is only a broad

general classification, and that the heart is very rarely displaced in an absolutely horizontal, or in an absolutely vertical plane. The exact direction taken in each variety will now be described, as well as its special causes, and the physical signs by which it may be recognised.

1. **Displacement towards the Left.**—This, the most common variety of marked cardiac dislocation, is most frequently caused by contraction of the left lung from any of the conditions already enumerated, and effusions into the right pleural cavity. Right pneumothorax, and tumours connected with the right side of the chest, with the mediastinum, or with the right lobe of the liver, are less common conditions that lead to the same result. The distance towards the left to which the heart is dislocated varies, the extreme limit being probably the vertical axillary line. During its progress towards the left, the heart is rotated around its longitudinal axis, so that the right ventricle is more exposed anteriorly; and the apex is moved, at first somewhat downwards, and afterwards upwards.

The visible and palpable impulse is found to the left of its normal situation, and either lower or higher than it, or on the same level with it, according to the degree of displacement. In some cases due to contraction of the left lung, the impulse may be found in any one or in all of the left intercostal spaces from the base to the apex of the heart, and of different rhythm in the different spaces. If the displaced heart be the seat of valvular disease, thrill may be felt in an unusual situation, for example, in the left axilla. The area of percussion-dulness is altered in outline, being invaded on the right side either by the dulness due to effusion there, or by resonance due to pneumothorax or to encroachment of the right lung-border; whilst it is either transposed towards the left axilla, or blended with unnatural dulness over the left lung. The cardiac sounds are reduced in loudness over the normal præcordium, whilst they are unnaturally loud towards the left axilla and up the left front. Structural murmurs if present are similarly transposed, as regards the seat of their greatest intensity and the lines of their convexion. A systolic murmur may be developed at the base of the heart from distortion of the great vessels.

2. **Displacement towards the Right.**—This form of dislocation of the heart is the result of effusion into the left pleural cavity; of contracting processes connected with the right lung or pleura; of left pneumothorax; and of tumours of the left side of the chest or in the mediastinum. The heart may be displaced towards the right side until the impulse is found in the axillary region. During its lateral movement, the heart is rotated on its longitudinal axis in such a manner that the left ventricle is more exposed; and, at the same time, the apex is first depressed towards the epigastrium, and afterwards raised towards the right axilla, as the displacement increases.

The physical signs correspond closely with those enumerated under left displacement—the two sides being, of course, exactly reversed. The cardiac impulse is most frequently transferred to the epigastrium and the region between that and the right nipple. A new area of pulsation is sometimes developed in the second and third right interspaces, close to the sternum, and indicates the displaced position of the right auricle, if præsystolic, or of the aorta, if systolic and followed by palpable shock in diastole. The description of the auscultatory phenomena, as regards both sounds and murmurs, does not require to be repeated.

3. **Displacement Downwards.**—This is an exceedingly common form of cardiac displacement, though seldom extreme in degree. It is the constant result of hypertrophous emphysema of the lungs; and may also be caused by the downward pressure of tumours at the base of the heart, such as aneurism, and by collapse of the stomach and intestines. Displacement of the heart downwards is limited by the diaphragm, and by the attachment of the pericardium and great vessels at the root of the heart. At the same time the apex may either move somewhat towards the left in its descent if the downward pressure be uniform, as in emphysema; or it may ascend somewhat towards the left if the pressure be exerted chiefly upon the base.

The ordinary cardiac impulse is generally quite imperceptible in this form of displacement, on account of enlargement of the lungs; or it is greatly weakened, and situated in the sixth left space, or lower, to the left of its normal position. A new area of systolic pulsation is perceptible in the epigastrium, generally well marked, and connected with the right ventricle. The præcordial dulness is usually completely replaced by pulmonary resonance; or, more rarely, confused by the dulness of some form of mediastinal tumour. The cardiac sounds are feeble, or absent, over their usual seat; and are heard, instead, over the epigastric triangle and the lower left cartilages.

4. **Displacement Upwards.**—The many abdominal causes of this form have been already mentioned, as well as the symptoms due to compression of the heart which characterise it when so produced. The heart, as a whole, is moved upwards in the chest, and at the same time the apex passes more or less towards the left, and the right ventricle may become somewhat more exposed anteriorly.

The cardiac impulse is elevated until it is found on the nipple-level, or even higher; or it is lost, along with the area of percussion-dulness, behind the inferior border of the left lung. The sounds of the heart are transposed upwards and weakened. The displacement of the cardiac apex towards the left axilla in pericardial effusion is described elsewhere. *See* PERICARDIUM, Diseases of.

5. **Displacement Backwards.**—This variety of displacement of the heart is very uncommon; and when it does occur, is generally referable either to abundant pericardial effusion, or to backward curvature of the spine (kyphosis) in the dorsal region. A certain amount of backward displacement is, however, not so rare in extensive excavation of the left lung, in association with other forms of dislocation. The base of the heart is then the part most transposed into the left paraspinal groove, and the apex is tilted somewhat forwards as well as elevated.

The physical signs of backward displacement are those of the cause of the malposition rather than any that can be referred to the condition itself.

6. **Displacement Forwards.**—Displacement forwards is also very rare, although it is frequently simulated by bulging of the præcordium in enlargement of the heart. The chief cause of it is the presence of a tumour in the mediastinum—especially aneurism of the descending aorta, or enlargement of the bronchial glands. The amount of actual transposition is necessarily exceedingly small, the anterior border of the lungs being compressed or pushed aside, but the further progress of the heart forwards being arrested by the anterior wall of the chest.

The physical signs are, therefore—increase of the area and strength of pulsation and of percussion-dulness over the præcordium; bulging of the same in young subjects; and increased loudness of the cardiac sounds in that situation.

7. **Complex Displacements.**—It has already been indicated that displacements of the heart, strictly speaking, occur almost without exception in more than one of the directions described; and they may all, therefore, be said to be generally more or less complex. Dislocation at once upwards and towards either side is especially common, as the result of contracting processes in the apex of the lung.

Diagnosis.—After the full account that has been given of the several forms of displacement of the heart, there ought to be no great difficulty in diagnosing them from each other, as well as from the conditions which simulate them. These must be carefully remembered. The chief of these are:—(1) physiological displacements, already referred to; (2) cardiac enlargement, especially when attended with bulging of the præcordium; (3) pulsating tumours of the chest and abdomen, particularly aneurism of the aorta; (4) adhesion of the pericardium; and (5) atrophy of the lungs from any cause.

Treatment.—The rational treatment of displacement of the heart would be to remove its cause; but when the cause is of the nature of traction, treatment is very rarely called for, even if it were possible. In displacement due to pressure, on the contrary, treatment is often urgently indicated, perfectly practicable, and highly successful. The unpleasant sensation of pulsation complained of in some instances of displacement—for example, in phthisis—is frequently relieved by an assurance on the part of the physician that the palpitation is of no import; and by the application of a simple plaster, containing iron, belladonna, or opium. J. Mitchell Bruce.

HEART, Embolism of. *See* Heart, Thrombosis of.

HEART, Fatty Degeneration of.—Synon.: Fr. *Dégénérescence graisseuse du Cœur*; Ger. *Fettige Metamorphose des Herzens.*

Definition.—The process by which the muscular fibres of the heart are converted into a granular fatty matter. The term is also used to express the state of the heart in which this change has been accomplished.

Ætiology and Pathology.—The process by which the protein elements of animal bodies, including muscular fibre, are converted into granular fatty matter, as well as the circumstances under which this change occurs, have been already so fully discussed under the head of Fatty Degeneration, that it is unnecessary to repeat what will be found there. It will suffice to say here, that when the process of nutrition is interfered with in the tissue of the heart, this change takes place, and is best illustrated in the *local or limited* form of disease, which occurs when the coronary circulation is obstructed. This is seen in cases of thickening or calcification of one of the trunks, or of the branches of these vessels, and is more marked by reason of the fact that the coronary arteries do not freely communicate with each other. The fatty change is found to occur in the more *diffused or general* form in those diseases in which the vital powers are lowered, as in certain forms of chronic cachectic disease, in poisoning by phosphorus, or after loss of blood. In certain other conditions, such as acute specific fevers, the tissue of the heart becomes softened, and under the microscope presents a granular appearance, which is believed by some pathologists to be an incipient stage of fatty degeneration. We might also refer to the more or less diffused form of fatty degeneration which takes place in cases of enlarged heart, the result, not, as Rokitansky supposed, of a disturbance of the nervous functions, but of the fact that these enlarged hearts require a larger supply of the materials for nutrition than can be furnished to them by the coronary arteries, which in such cases are frequently themselves diseased, both at their origin and in their course. Lastly, fatty degeneration of the heart is found to occur after delivery in some instances, in which the organ had become enlarged during pregnancy.

Certain other circumstances connected with the origin of the disease require to be mentioned here. In reference to *sex*, the disease is more frequent in males, in the proportion of nearly two to one. With respect to *age*, in his original memoir on this subject, the writer found that nearly one-half of all the cases observed were over sixty years of age. In the late Dr. Hayden's valuable work on *Diseases of the Heart*, the proportion stated of cases under sixty years of age shows a larger number of young persons whose hearts have undergone this change as a result of wasting disease—a result which is evidently due to the greater care with which microscopical examinations of the heart have been made in recent times. As regards social position, of thirty-three cases formerly noted by the writer, the subjects of the disease are stated to have belonged to the higher ranks in nine cases; to the middle class in eight cases; and to the lower class in sixteen cases. This enumeration contrasts with the proportion in which fatty growth appears on the heart; seven of fifteen cases belonging to the first class; six to the second; and only two to the third. Fatty degeneration and fatty growth on the heart are thus seen to occur under very different conditions. The latter is the result of the accumulation in the blood of the elements of fat; the former is the result of decay and disintegration.

Anatomical Characters.—In fatty degenera-

tion the heart is found to be enlarged in about two-thirds of the cases recorded both by Dr. Hayden and the present writer. It is not unfrequently simply dilated. To find a fat heart of an average size, or even occasionally below it, is not a very exceptional occurrence. The colour of the heart's substance is pale, sometimes as pale as 'a dead leaf,' but more generally it is of a yellowish-brown or buff, or muddy pink colour. This discolouration is generally seen in spots or patches; and though the whole heart may be pale, the spots being still paler when seen beneath the endocardium, give the tissue a mottled look. The same appearance may be seen beneath the pericardium, and in the substance of the heart. With the progress of disease the spots run together, giving portions of the walls a uniform buff-coloured character, whilst the rest of the organ retains its ordinary aspect. The consistence also varies from that of mere flabbiness or softness, to such a condition as permits of the tissue being torn like wet brown paper. The organ then feels like a piece of wet chamois leather, or a wet glove. In other cases the heart retains in appearance much of its ordinary solidity, but the tissue breaks down on pressure, as does a lung consolidated by pneumonia. This is a state which more frequently occurs in hypertrophied hearts. In addition to these changes in size, colour, and consistence, others have to be noted. The fibrous character of the heart's structure, even to the naked eye, disappears; in some cases the tissue resembles that of a fatty or boiled liver. In other instances the cut or torn surface has a granular appearance, not unlike that of the lung in an early stage of grey hepatization. These different appearances may in a great measure be due to the greater or less fluidity of the oily matter present, as well as to the extent and degree to which the disease has advanced. Further varieties in appearance may be caused by the presence of a greater or less quantity of blood, or of its colouring matter, in the heart's texture or in its cavities, by which the lining membrane may in the latter case be dyed of a deep purple colour.

Microscopical characters.—The microscopical characters of this disease will be found so fully described under the head FATTY DEGENERATION, that it is needless here to do more than refer the reader to that article.

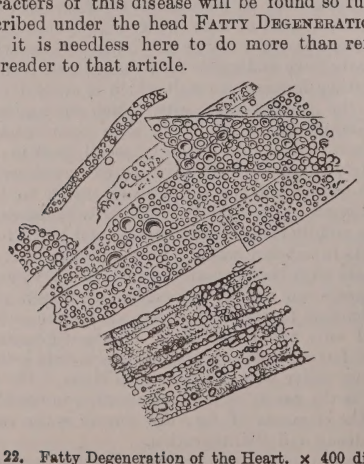

FIG. 22. Fatty Degeneration of the Heart. × 400 diam.

All parts of the heart's fibres are subject to fatty degeneration, but not equally so. It is most frequently found in the left ventricle; next in the right ventricle; then in the right auricle; and least frequently in the left auricle. It is generally more evident in the columnæ carneæ, and in the inner layers of the muscular walls, than elsewhere.

EFFECTS.—Of the *structural* lesions occurring in the heart when the seat of fatty change, one of the most important is *rupture*, which was found in twenty-five out of sixty-eight cases of fatty or softened heart, the histories of which were collected by the writer. Partial rupture leading to the formation of what has been called *cardiac apoplexy*, is another condition which has been described. The clot in such cases, if it lose its colour, may produce an appearance like an encysted abscess; and a consecutive false aneurism of the walls of the heart may be thus formed, as well as by simple yielding of a portion of the softened cardiac wall. The involvement of the columnæ carneæ may lead to imperfect action of the valves. Valvular disease itself is not often present in connection with fatty heart. Dr. Henry Kennedy, in a recent interesting work on this subject, points out that the valves are affected only about once in nine cases; and he further shows that, when the valves are affected, it is chiefly the aortic valves that are involved.

Of the effects of fatty degeneration upon the *functions* of the heart, the most prominent are those which exhibit the deficient powers of the organ. *Coma*, preceded or not by giddiness, has been described by several writers in connection with feeble powers of the circulation. Dr. Adams of Dublin has mentioned as many as twenty attacks in one of his cases of fat heart; and the writer has noticed the occurrence of even more frequent seizures. *Syncope*—'cardiac syncope' is a term very frequently used by the older writers; and it is a term which may be well applied to the condition of faintness which is frequently found in connection with fatty heart. In some cases the feeling of syncope amounts to nothing more than a simple sense of faintness—that the patient must fall if he do not lay hold of something. In other instances this symptom is accompanied by a feeling of impending death; and such patients do frequently die. In the cases collected by the writer, thirteen out of thirty-three died of what he proposed to call *syncope lethalis*, or 'fatal syncope;' and it would be possible, no doubt, now greatly to extend the number of cases that have proved fatal in this way. Death may result in such cases from cardiac failure, as indicated by a flabby heart containing blood in the left ventricle; or, where there is a less amount of degeneration, by irregular action or spasm, with emptiness of the ventricles.

Pain is another effect. It may occur independently of, or be associated with syncope—*syncope anginosa*. *See* ANGINA PECTORIS.

The *respiration* is considerably affected, in all cases of fatty degeneration, either as simple breathlessness, especially on exertion, or in that peculiar form which has been called *Cheyne-Stokes respiration*.

SYMPTOMS AND DIAGNOSIS.—There is no doub

that many cases occur in which fatty degeneration is found in the heart after death, where its presence during life had not been suspected. This is more especially the case in those examples of exhausting disease in which the heart participates. In such cases the requirements of the system may not be out of proportion to the powers of the heart; and death may come on slowly and insidiously without our attention being attracted to the state of this organ. In a second class of cases, in which the heart suffers from some local cause, as, for example, from disease of the coronary arteries, whilst the system generally maintains its powers more or less fully, the balance between the system and the heart is lost, and diagnostic evidence of the change that has occurred in the central organ, sufficiently clear and pointed, may be traced without difficulty. Amongst the symptoms of the disease we then observe various modifications of the phenomena of drowsiness and coma; faintness and syncope; disordered respiration; pain in the region of the heart; and disturbed pulsation. For example, the patient complains in the earlier stages of being easily exhausted, particularly by mounting heights; he feels, he says, faint on reaching the top of the stairs; though not giddy, he feels he must fall; though not breathless or fainting, he sighs deeply and seeks the air. Any unusual excitement, a heated or a close atmosphere, produces the like effects. At the same time there is often experienced an uncomfortable feeling of choking or fulness in the chest. In the intervals the individual may be fairly well.

As the disease advances, the attacks become more frequent and severe, and often disturb and distress the patient at night. The temper is observed to become irritable. The expression of the features frequently appears anxious, and the countenance sallow. Copious perspiration from very slight causes, sometimes coldness of the extremities and swelling of the ankles, appear amongst the incidents of the disease. The pulse is generally affected; but how must no doubt depend in a great measure upon the part of the heart affected, and on the extent and degree of the disease. In the writer's opinion, intermittence and irregularity are the more frequent alterations; weakness is another; and slowness—often remarkable—is a third. Quickness of the pulse, more especially when it increases with age, has been dwelt upon by Dr. Kennedy as a symptom deserving of attention in the diagnosis of fatty degeneration. The irregularity may be constant. The writer has seen it present during the slight disturbances above described; and he has seen it disappear altogether when the patient was in tolerable health, to return as the effect of any depressing cause, the more marked because that cause may be far too inefficient to affect a sound heart.

The breathing is always more or less affected in cases of fatty degeneration of the heart. In some instances it is represented as a sense of choking or suffocation; the person feels as if he were breathing through a sponge. The difficulty in some instances is so slight as scarcely to be regarded; in others so severe that the smallest effort, particularly in mounting ascents, is most painful. A peculiarity sometimes observed is that the ascent of a gentle height is distressing, while the person can read aloud without inconvenience. A character of the respiration first described by Dr. Cheyne of Dublin, and afterwards by Dr. Stokes, is by some regarded as diagnostic of fatty degeneration of the heart. It is thus described by Dr. Stokes: 'A form of respiratory distress peculiar to this affection (fatty degeneration of the heart), consisting of a period of apparently perfect apnœa, succeeded by feeble and short inspirations, which gradually increase in strength and depth until the respiratory act is carried to the highest pitch of which it seems capable, when the respirations, pursuing a descending scale, regularly diminish until the commencement of another apnœal period. Dr. Hayden, in writing on this subject, mentions a case in which during the period of apnœa there was no change in the heart's action; a second case in which the action of the heart and the pulse underwent no change during the period of apnœa and dyspnœa; whilst in a third case, during the paroxysm of dyspnœa, the heart's action was remarkably irregular. It should be stated with regard to this symptom that, though frequently present, it is by no means characteristic of fatty degeneration only. It is by some said to be more frequently associated with disease of the aorta. Various explanations of this phenomenon have been given. Dr. Little (*Dublin Journal of Med. Sci.*, No. 91) believes that it is due to derangement of the dynamic adjustment between the right and left ventricles of the heart. Dr. Hayden (*op. cit.*) connects it with atheromatous or calcareous change with dilatation of the arch of the aorta, involving loss of elasticity in its walls. The late Professor Laycock thought (*Dublin Journal of Med. Sci.*, July 1873) that this phenomenon de pended upon 'sentient palsy of the respiratory centre,' or 'a paresis of reflex sensibility of the mucous membrane of the lung.' *See* RESPIRATION, Disorders of.

Another phenomenon, said to be diagnostic of fatty degeneration of the heart, is arcus senilis—a pearly crescentic opacity of the upper and lower portions of the circumference of the cornea, which must be distinguished from the opaque annulus which occasionally surrounds the entire cornea. Mr. Canton was the first to describe the nature of this change as fatty degeneration. It is quite true that when fatty degeneration is present in the cornea it may possibly be found in the muscular fibres of the heart and in the arteries. Still it by no means follows that the degeneration must exist in any particular part or organ; and therefore this appearance in the cornea cannot be regarded as at all pathognomonic of fatty degeneration of the heart.

As the disease progresses still farther, the symptoms become more marked; the various effects of feeble and languid circulation show themselves; angina may perhaps become fully developed; or the patient may be cut off suddenly by one or other of the effects connected either immediately or remotely with the lesion itself. Of eighty-three cases of 'fatty disease' of the heart collected by the writer, sixty-eight died suddenly.

Physical Signs.—The physical signs that characterise fatty disease are not many. They are—a feeble impulse of the heart, proportionate to the extent and the degree of the disease; a feeble muffled first sound, under like conditions, sometimes scarcely audible. When the heart is enlarged, the impulse will be extended, and so likewise will be the dulness. A murmur may be present, as suggested by Rokitansky, from degeneration of the columnæ carneæ. The second sound is often distinct and clearly accentuated, as compared with the first.

Diagnosis.—The diagnosis of the presence of this degenerative change in the absence of any alteration in the size of the heart must be founded upon a consideration of the symptoms and physical signs above described. When the heart is hypertrophied or dilated only, the presence of fatty degeneration is more difficult of diagnosis by its physical signs. We must then seek to trace how far the usually well-marked signs of hypertrophy of the organ are modified by those we have described as being present in, and characteristic of, fatty degeneration. The same observations will apply to dilatation or thinning of the walls. This special condition has its own well-marked phenomena, which will be found described elsewhere (*see* Heart, Dilatation of). These signs will be more or less modified in proportion to the degree and extent of any fatty change that may be present.

Progress, Duration, and Terminations.—It is impossible to determine the duration of a disease the date of origin of which is in most cases very obscure. Still there are grounds for believing that persons with a certain amount of degenerated tissues in their hearts have gone on living during periods extending over thirty or forty years. On the other hand, death has occurred from fatty degeneration of the heart, determined *post mortem*, in which the entire absence of symptoms until a few months before the fatal event justified the opinion that the duration of the disease had not much exceeded the period just mentioned. When fatty degeneration occurs as the result of phosphorus-poisoning, or of certain exhausting diseases, the progress of the change, which can be determined, is rapid. In such cases, the morbid process is not confined to the heart alone, and therefore when death occurs, it cannot well be attributed solely to the condition of this organ.

Death from fatty disease of the heart is frequently sudden, the proportion being as five to one compared with other modes of death, this disease existing to a noticeable extent. The immediate causes of death are those which have been already alluded to when treating of the *effects* of the disease, namely, syncope, coma, and rupture of the heart; the first and last of these contributing nearly the whole number of those that die suddenly. Such facts indicate very strongly the necessity of avoiding any mental excitement or physical exertion which might lead to these results. Here it might also be well to remember, with reference to the administration of anæsthethics, that chloroform has an especially depressing effect on the heart's action, and that when the heart's power is enfeebled by the disease which we are here describing, a very small dose of this anæsthetic, which would have little or no effect on a healthy heart, may prove fatal. This opinion was first expressed by the writer many years ago, and it has been fully confirmed by numerous cases of death which have occurred during the administration of chloroform.

Prognosis and Treatment.—The prognosis of fatty degeneration of the heart will depend in a great measure upon a knowledge of its cause and its extent. In cases where the disease originates in constitutional causes, such as in phosphorus-poisoning, and in cases where it is of the nature of involution—for example, after parturition—there is good ground for believing that, the cause being removed, the effect will cease, and a fairly healthy condition of the organ be restored. On the other hand when the coronary arteries are obstructed, and degeneration is thereby set up, or when nutrition generally is impaired, and all the tissues are more or less undergoing this change, the prognosis must be in the highest degree unfavourable, more especially so if in the latter case the patient cannot be placed in a condition by which this degenerative tendency may be counteracted. The treatment consists in the adoption of all the measures calculated to improve the general health—such as pure fresh air, wholesome food, and temperance, together with moderate exercise, either carriage, riding, or walking, if it can be accomplished without causing pain or breathlessness. Everything which may tend to lay stress on the heart's action, such as walking uphill or making efforts, or mental excitement, should be avoided. With reference to drugs, such tonics as can be best tolerated by the patient might be given. We may mention iron—especially dialysed iron—phosphorus in small doses, and strychnia. Special attention must be paid to the condition of the excretory organs, such as the kidneys and liver, which are liable to become congested when the cardiac action is feeble. Lastly, it may be said that in cases of syncope, in addition to the administration of the usual stimulants, galvanism applied from the back of the neck to the præcordium by the interrupted current. has in a few instances been known by the writer to be useful. For further information on the subject of Fatty Degeneration of the Heart the reader may consult the complete and very valuable article by Dr. Hayden in his work on Diseases of the Heart; and a memoir by the writer in the 33rd volume of the *Medico-Chirurgical Transactions* (1850). R. Quain, M.D.

HEART, Fatty Growth on.—Synon.: Fr. *Hypertrophie graisseuse du Cœur*; Ger. *Fettige Infiltration des Herzens.*

Definition.—The growth of fat on the surface and in the substance of the heart, in quantity sufficient to interfere with its functions, and thus to constitute a disease.

Ætiology.—In our inquiries concerning the cause of this condition, we are met with the problem, still to be solved, Why are certain individuals, and certain parts of the body, more prone to the formation of fat than other persons and other parts? We can ascertain with some degree of certainty the circumstances which promote the formation of fat in general; and obser-

vations collected by the writer and others show that when fat is thus formed throughout the system, the heart is likely to partake largely of the accumulation. We may accordingly refer to the article OBESITY, in which the causes of fatty growth in general will be found discussed.

Of fifteen cases of extreme fatty growth on the heart collected by the writer, eleven occurred in very fat individuals, and only one in a person who was described as being 'thin.' Age seems to exert a decided influence upon the formation of fat upon the heart. It is very scanty in infancy, and is rarely present in any quantity before the thirtieth year. Corvisart, however, quotes from Kercking the case of a child whose heart seemed wanting, so great was the quantity of fat in which it was embedded. Of the fifteen cases just referred to, thirteen were above fifty years, and one only under that age. Males, according to the same data, are more liable to accumulation of fat on the heart than females, the respective numbers being as twelve to three.

ANATOMICAL AND PATHOLOGICAL CHARACTERS. A certain amount of fat-tissue, which is not inconsistent with health, occupies a definite position in the structure of the heart. It is seen most abundantly in the groove between the auricles and the ventricles; and as the distribution of this tissue bears a relation here, as in other parts, to that of the blood-vessels, it first appears in the course of the primary branches of the coronary arteries; then in the course of the secondary branches—that is, in the groove over the septum, which marks the boundary between the ventricles; and, lastly, it follows the distribution of the small lateral branches. These branches are more superficial over the right ventricle than over the left; hence the former is found always and more abundantly covered with fat. A fringe of fat is also found at the apex of the heart; and frequently around the margins of the auricles. A mass of superabundant fat will of itself be sufficient to press on and embarrass the action of the heart; but fat rarely exists in this abundance on the surface of the organ without insinuating itself between, and encroaching on, the muscular fibres. In this way the muscular portions of the walls of the organ become thinner and thinner, until the columnæ carneæ may appear to arise from a mass of fat. This state constitutes what was once regarded as fatty degeneration of the heart, and which has also been called 'fatty metamorphosis;' but it is in many cases nothing more in reality than a simple hypertrophy of fat. In parts of hearts which are less affected, that is, where fat is not very abundant, simple striæ of yellow tissue will be observed lying amongst the muscular fibres—an appearance often found in the auricles.

Microscopical appearances.—When a portion of heart suffering from fatty growth in a high degree is examined with the microscope, it will be found that where the growth is most advanced, that is, towards the external surface, very few muscular fibres can be seen, and that the very wide intervals between them are occupied by fat-cells. (See Fig. 23.) Proceeding inwards, the muscular fibres become more evident; the fat-cells become fewer; and, finally, we reach the muscular fibres beneath the endocardium, with a few fat-cells lying here and there amongst them. It is worthy of note that the fibres, though overwhelmed by fat, may still retain their organisation. In all cases, however, the course and direction of the fibres are more or less modified and distorted. The fact that the fibres still exist, though concealed, affords an explanation of

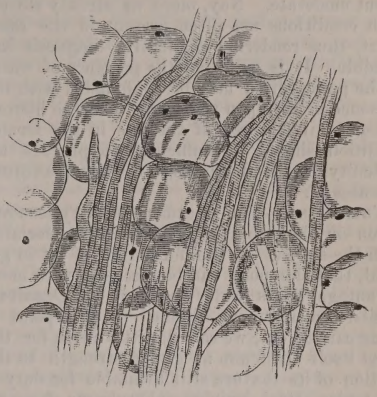

FIG. 23. Fatty growth in the substance of the Heart. × 400 diam.

the persistence of the heart's action in those instances in which the muscular walls appear to a greater or less extent replaced by fat. It might also be mentioned that small masses of fatty tissue sometimes appear beneath the endocardium, varying in size from that of a pin's head to that of a pea. The writer has seen these little fatty tumours in cases where there was a considerable, but not an excessive, amount of fat upon the surface of the heart.

EFFECTS.—The fat accumulated on the heart and in its substance, may be supposed to act mechanically; and by its pressure upon the muscular fibres, on the nerves, and on the blood-vessels, to impede the function of the organ, embarrass its nutrition, and produce those effects which may be briefly enumerated as—a languid and feeble condition of the circulation, with a sense of uneasiness and oppression in the chest; embarrassment and distress in breathing, drowsiness, even coma; syncope, perhaps angina pectoris, it may be death. Rupture of the heart sometimes results. Such an enumeration of evils, in which there is no evidence of any other lesion of the heart's texture, save an accumulation of fat, would suffice to render this condition a source of very grave import, but we cannot always be quite clear on the subject, because in the particular cases quoted we cannot be certain that some degeneration of the muscular fibres did not co-exist. It would be well, therefore, not to dwell too much on such effects as proceeding from and dependent on fatty growth alone.

DIAGNOSIS.—The presence of an excessive deposit of fat about the heart must, in a great measure, be a matter of inference during life. Where one or more of the effects mentioned above as having been noticed in cases of this kind, are present; when the pulse is small and weak; when the first sound of the heart is

feeble, and the impulse weak; when the extent of dulness on percussion is increased; and when these phenomena occur in a fat person, it may be inferred that the heart is too fat.[1] But, on the other hand, it must not be overlooked that these symptoms and signs may be found in cases of fatty degeneration of the walls of the heart, in cases where the amount of fat-tissue is but moderate. Nay, more, as already stated, both conditions are often present in the same heart, thus rendering distinctive diagnosis impossible. It is said that the presence of water in the pericardium may be confounded with the presence of fat upon the heart; but the history and general features of the case in the former condition should be sufficient to prevent all difficulty in the diagnosis. *See* PERICARDIUM, Diseases of.

TREATMENT.—The treatment of fatty accumulation on the heart is so intimately associated with the subject of the formation of fat in general, that this point can be discussed with more advantage in its wider relations (*see* OBESITY). Whilst the treatment directed to this point is being carried out, we can do little more for the heart itself than aim at giving strength to the portion of its texture still available for duty—by tonics, steel, quinine, phosphorus, &c.; secondly, by lightening as far as possible the work which the heart has to do; and thirdly, by attending to the excreting organs, so as to prevent congestion there, and consequently embarrassment to the weak heart. R. QUAIN, M.D.

HEART, Fibroid Disease of.—SYNON.: Chronic Myocarditis.

DEFINITION.—A morbid condition in which the muscular fibres of a portion of the walls of the heart are replaced by fibroid tissue.

ÆTIOLOGY.—Fibroid disease of the heart is met with most frequently in middle-aged male subjects. The disease is supposed to be occasionally but an extension between the muscular bundles of a chronic process that has commenced with endocarditis or pericarditis. The cause of this, which is generally rheumatism, is then regarded as the cause of the fibroid growth; but in reality it is more probable that in such cases the serous inflammation is the result, and not the cause, of the fibroid change. Fibrosis is sometimes the consequence of acute interstitial myocarditis. In a considerable number of cases of fibroid disease, and in most of the cases of so-called 'fibrinous deposit,' the change is probably syphilitic in its nature. In other instances it appears to be senile, and to be associated with degenerative changes in the vessels, or chronic disease of the kidneys. Increase of fibrous tissue in the myocardium may also be the result of prolonged moderate congestion of the coronary veins. Very frequently no evident cause of the disease can be discovered.

ANATOMICAL CHARACTERS.—Our knowledge of the pathology of this disease is in a great measure due to the remarkable number of cases that have been described in the *Transactions of the Pathological Society*, the first specimen of which was presented by Dr. Quain in the year 1850. Fibroid disease of the heart occurs most frequently in the walls of the ventricles. It is met with under several different forms. In rare instances, which are best described as cases of *connective-tissue hypertrophy* of the heart, there is an uniform increase of fibrous tissue between the muscular fibres throughout the whole organ (*see* HEART, Connective-Tissue Hypertrophy of). In other instances, the disease appears as a local thickening of the connective tissue underneath an opacity of the endocardium or of the pericardium, whence septa run outwards or inwards between the muscular bundles. Most frequently, however, it presents the appearance of a *fibroid patch*, generally situated near the apex of the heart, replacing the muscular substance throughout its whole thickness, and over a greater or less extent of surface, even to as much as a considerable portion of one ventricle, and consisting of dense, firm, inelastic, greyish-white fibrous tissue. Smaller patches, nodules, scars and streaks may be found in the deeper parts of the myocardium. The apices of the papillary muscles, again, may become fibroid, especially in chronic valvular disease. Polypoid tumours, composed of fibrous tissue, have been met with on the endocardial surface of the heart, that is, projecting into one of the cavities; more especially into the left auricle. Possibly the detachment of such a polypus may be one mode of origin of the 'fibrinous balls' or 'concretions' occasionally found lying free in the auricular cavities. Fibroid and 'fibrinous' formations due to syphilis are described in the article HEART, Syphilitic Disease of.

Microscopically, fibroid disease of the myocardium presents a concomitant increase of the connective-tissue elements, and decrease by atrophy of the muscular fibres. Occasionally, in an early stage, as well as at the margins of the older patches, round and spindle-shaped cells and bundles of young fibrillæ have been observed. The latter increase in size and in number, press upon the intervening muscular fibres, and finally unite and form bands or patches of ordinary fibroid tissue. Meanwhile, the muscular fibres gradually become attenuated, granular, or fatty; and at last they disappear by absorption, or patches of them may be imprisoned within the fibroid growth.

The effects upon the heart of fibroid changes in its walls vary with their situation and extent. If a large portion of the wall of one cavity is fibrotic, irregular patchy dilatation of the chamber ensues. Localised fibrosis, especially if it commence beneath the endocardium, gives rise to aneurism of the heart, by the yielding of the diseased area to the intra-ventricular pressure (*see* HEART, Aneurism of). Deeper

[1] Dr. Henry Kennedy, of Dublin, in a recently published special monograph on *Fatty Heart*, states that the points upon which the diagnosis of fatty growth on the heart mainly turn are the following:—'First, a large full pulse, beating at the natural standard of frequency; secondly, evidence derived from percussion of the heart's dulness being more extended than natural; thirdly, the possible presence of a soft systolic murmur over the aortic orifice, occupying the first sound of the heart only, and leaving the second normal; and, lastly, the condition of the individual as to his being fat or otherwise' (p. 39). The present writer hesitates to agree with Dr. Kennedy as to the condition of the pulse generally, and certainly this description will not apply in the cases of those persons of small frame, with small arteries, who often become obese and present symptoms of fat-heart after the middle period of life.

or more limited patches or lines of cirrhosis cause irregularity or puckering of the cardiac walls; and valvular insufficiency may result from this, or from fibrosis and functional disturbance of the papillary muscles. Lastly, fibroid disease occasionally involves the conus arteriosus in an annular form, giving rise to constriction and the formation of so-called 'cardiac stenosis.'

Symptoms.—The symptoms of fibroid disease of the heart vary greatly in different instances, according to the extent, situation, and other conditions of the growth. When the fibrosis is very limited, few symptoms can be expected to be present. In the majority of cases in which a considerable portion of the cardiac wall has been found diseased, the symptoms have been described as those of 'ordinary heart-disease'; namely, dyspnœa on exertion; præcordial pain or distress; occasional palpitation; small, weak, or irregular pulse; dropsy; and visceral complications. As a rule, no endocardial murmur has been present; but fibrosis of the papillary muscles may sometimes give rise to the signs of incompetence of the auriculo-ventricular valves. The symptoms of cardiac aneurism and of syphilitic disease of the heart, as well as those of connective-tissue hypertrophy, are elsewhere described.

Course and Terminations.—The course of fibroid disease of the heart is generally chronic, although urgent symptoms are sometimes observed a short time only before death. Attacks of pain, palpitation, and dyspnœa may occur and subside long previous to the last fatal illness. The development of cardiac aneurism, and its possible terminations, will modify the course of the disease. Sudden death may occur, with or without previous cardiac symptoms, and must be regarded as a special mode of termination of fibroid disease of the heart. Otherwise the cases generally end by pulmonary complications, dropsy, and exhaustion.

Diagnosis.—Fibroid disease of the myocardium has to be diagnosed from chronic valvular disease; from enlargement due to extracardiac causes, such as renal disease, gout, or emphysema; and from fatty degeneration. Under all circumstances, an accurate diagnosis is extremely difficult, if not impossible. The presence of a murmur does not exclude fibrosis, as the valves may become secondarily involved; and valvular disease is not always attended by a murmur. The other cardiac lesions mentioned must be excluded in the ordinary way.

Prognosis.—When fibroid disease of the heart is attended with symptoms sufficient to establish a diagnosis, the prognosis is unfavourable as regards life, although it may not be immediately so.

Treatment.—This consists in relieving and supporting the heart by every possible means, especially by rest and cardiac stimulants, such as alcohol and ether. Iodide of potassium may be given with benefit in some cases, especially if there be a history of syphilis. Digitalis will have to be administered with great circumspection. J. Mitchell Bruce.

HEART, Functional Disorders of.

Definition.—A disturbance in the functions of the heart, with or without pain; having origin in causes other than inflammation, or structural changes in the heart itself; and for the most part paroxysmal in character.

This definition comprises various disorders in the dynamical functions and sensibility of the heart, from the slightest disturbance of only momentary duration, to urgent symptoms of considerable persistence.

Ætiology.—The frequency of the occurrence of functional disorders of the heart, and the similarity of many of the symptoms exhibited to those met with in organic diseases, as well as the fact that these functional disorders may coexist with organic disease, thus greatly exaggerating the apparent gravity of the latter, render it important to accurately determine how much of the disturbance may be due to the one or to the other of these causes.

To estimate the *immediate* or *proximate* cause of functional disturbance of the heart, regard must be had to its structure; and how this is nourished, and its motions regulated. For adequate and equable dynamical movement, the primary requirement is a healthy development of muscular structure. Weak muscular fibre, apart from degenerations by disease, becomes a predisposing cause of feeble and irregular action. But as the regular recurrence of the muscular contraction and expansion must, moreover, be ascribed to the agency of the cardiac ganglia, the vagus nerve, and the nerves and ganglia of the sympathetic system, all nourished and excited by the blood, any abnormal conditions of these have also their effect. Interference with the functions of these several nerves may so modify the action of the heart as to cause deficiencies of power of every variety and extent, giving rise to illustrations of abnormal contractility and irritability, which the heart exhibits in common with all other muscles. But the heart further possesses the distinguishing feature of rhythmical action. There are cogent grounds for the belief that this is not only due to the intrinsic ganglionic system of nerves; but, as errors of rhythm are certainly induced by such causes as improper diet, dyspepsia, the presence of worms, constipation, injuries or deformities of the chest, and diseases of the lungs, there can be no doubt that the heart is also liable to reflex irritation of the pneumogastric and sympathetic nerves. The rhythmical action is also shown by experiment to be dependent on the blood, whether venous or arterial; for without a supply of blood rhythmical action ceases. The healthy action of the heart, and the controlling energy of its nerves, greatly, if not entirely, depend on the supply of healthy blood; and any failure of the supply, whether in quantity or quality, shows itself by disturbance in the functions of the heart. Moreover, the muscular substance of the heart itself is nourished by the blood circulating in the coronary arteries, and thus becomes susceptible to the quality and condition of the blood so distributed; hence a blood too rich in fibrin or red globules, and thereby inducing plethora, frequently causes over-action of the heart and palpitation, whilst in anæmia a deficient amount of blood induces a weak and often excited and irregular action. The predisposing causes, in addi-

tion to those already named, may, therefore, be classed thus:—(1) Those conditions acting through or upon the nervous system, such as the general exhaustion of the nervous system, all forms of reflex irritation, venereal excesses, vain longings, purposeless occupations and amusements, protracted mental exercise, abstinence from adequate repose, &c. (2) Those conditions acting upon the general blood-supply of the body, and consequently affecting the special blood-supply of the heart, such as the turgid and plethoric states of gross feeders, depraved states caused by bad and deficient diet, and all forms of blood-disorder, as anæmia, gout, scurvy, &c. To these must be added the special temperament and personal peculiarities of the individual, a congenital or superimposed want of vigour, general debility, deformities of the ribs and spinal column, a small weak heart, uterine irritation, hysteria, adynamic fevers, and the special sanitary influences under which the individual is placed. Amongst the immediately exciting causes may be named mental shock or distress; protracted and unusual physical exertion; various articles of diet, as tea, coffee, &c.; tobacco in excess; many medicines, as aconite and digitalis; as also prolonged abstinence, exposure to cold, and notably blows on the epigastrium.

Symptoms.—A paroxysmal attack of a functionally increased impulse is often accompanied by a series of nervous sensations—such as a feeling of choking, at times amounting to a true *globus hystericus*; flushing of the face; heat and pain of the head, with a sensation of a whizzing, or rushing upwards of the sounds of the heart; dimness of vision, with photophobia; and a tendency to syncope, and to clammy perspirations with cold shivering. The voluntary muscles may refuse to act, so that the gait becomes tottering, or the patient grasps adjacent objects to steady himself, yet there is neither paralysis nor vertigo. The respiration, though not generally embarrassed, may become irregular and oppressed, presenting the phenomena of a short inspiration with a prolonged expiration; but if the paroxysms have been induced by a congested state of the right heart from using undue exertion, independently of any frequency of cardiac impulse, the breathing may be accelerated and accompanied with dyspnœa, or even apnœa, and a short dry cough. Illustrations of this class of symptoms often occur in those of sanguine and nervous temperaments; and may be the result of violent and too protracted exercise, of emotional excitements, or of the over-indulgence in stimulants or food when associated with lives of idleness and inactivity. Should the increased impulse be associated with rhythmical disturbance, there is for the most part consciousness of the existence of such states, more especially on the first ingress of the attack, so that it becomes a source of much anxiety and even of terror, inducing the self-conviction of the existence of organic disease. The head-symptoms also become more marked, and associated with local pains and *tinnitus aurium*; whilst the breathing is marked by sighing, and often becomes lessened in frequency. The irregular form of nervous palpitating heart is often associated also with hæmic diseases, and with nervous affections, as chorea, masturbation, &c. When such diseases as scurvy or chlorosis exist, the attacks become less paroxysmal and more persistent; there is more pectoral complication, even to dyspnœa; the headache is sometimes so bewildering that the mind becomes alarmed with vague apprehensions of danger, which give rise to general restlessness; the integuments over the region of the heart, as well as of the face, and even of the extremities, may become puffy and œdematous, especially in cases of extreme chlorosis, with enlargement of the thyroid gland and exophthalmos, where the morbid conditions inducing these may also possibly cause the irregular palpitation.

When functional disorder occurs with a diminished impulse, the general symptoms group themselves under anxiety and lowness of spirits, or actual despondency, with mental and bodily incapacity for exertion; flatulent dyspepsia, with cold clammy extremities; anorexia, or, may be, depraved appetite; exhaustion, with tendency to faintness; and, should irregularity of cardiac action be very marked, there may be a sensation of præcordial pain. Males are more subject to this form of functional disorder than females, and it chiefly occurs in persons having a normally small and feeble heart, or where a state of general nervous debility is superimposed.

When the distinctive feature of functional disorder is rhythmical error, and this is appreciable to the patient, the special symptom is that of extreme anxiety, even to the fear of impending death; occasionally a single intermission is so prolonged as to induce the impression that escape has only occurred by a miracle. These alarms often induce a palpitation not belonging to the rhythmical disorder. But if the rhythmical error be associated with a deficiency of systolic force, temporary paralysis of the heart's action or syncope may be induced, and in some extreme cases the functions may be weakened even to extinction. Such forms of disorder occur in those having normal but weak hearts; in the dyspeptic; in the gouty, especially if an attack is impending; and in those whose habits and occupations involve exhaustion of the nervous system. They are a characteristic of old age, but may be sympathetically induced in the young; and may be observed in the course of many diseases, such as tuberculosis, rheumatism, liver-affections, or when malignant disease is making its ravages.

Præcordial pain is by no means an unusual symptom accompanying functional affections of the heart; it may aggravate the urgency of these disorders, yet appears to be little influenced by them. The pain does not march *pari passu* with the irregularity or strength of the impulse. The pain may be persistent, while the associated disease may be paroxysmal; and in this respect it differs from *præcordial anxiety*, which is essentially paroxysmal, and acquires urgency from the symptoms with which it may be associated.

Physical Signs.—The physical signs referring to the cardiac action may be conveniently separated into the following groups, although in practice they will be found mingled or associated

with each other:—(1) Increased or diminished *impulse*, connected or unconnected with increased rapidity or rhythmical irregularity; (2) *rhythmical disturbance*, with intermissions, the impulse being normal or diminished; (3) increased or diminished *frequency*, the rhythm and force being normal.

(1) The cases in which an *increased impulse* is the distinctive feature of the heart's disturbance present many varieties, chiefly referable to force and regularity; but to the simple forms of increased and accelerated impulse there is so very frequently added rhythmical disturbance, that this complication is perhaps the one most usually occurring. The rhythmical disturbance may occur both in the force and the rapidity of the systolic contractions, or it may result in a true intermittence, or occasionally the irregularities thus induced may be so great as to defy definite appreciation, save as a tumultuous whole. On palpation, the impulse, abrupt in stroke, presents the characteristic of a sudden bound, now strong, now failing, sometimes so rapid as to communicate the impression of a fremitus or agitation, then a pause, or true intermittence followed by hurry, or more evident irregularity. On auscultation, the sounds are more difficult of appreciation than in simple palpitation; they are loud and clear, and sometimes so exaggerated and pronounced as to be audible both in the mammary and epigastric regions. But whether the exaggerations of sound and impulse be more or less, they will be found to act in unison with each other; the impulse and sounds increase together and diminish together. When there is an unusual amount of irregular functional excitement in systole, there may be occasionally heard, as a passing not permanent occurrence, a reduplication of the second sound, very rarely of the first; and usually the first portion of the divided or cleft sound is the most accentuated. This reduplication, though it may be met with in active inflammatory diseases, is chiefly the concomitant of functional disorders of the nervous heart only, and it rarely or never occurs in chronic diseases of the heart. The pulse is generally sharp and jerking; it does not always beat in unison with the systole of the heart; if there be plethora, it has a force and fulness not otherwise observable; and if there exist congestion of the right ventricle, it becomes contracted and diminished in force.

In cases where the *impulse is diminished* in effort, the special characters are somewhat negative; the impulse and sounds being feeble, but otherwise normal, unless the systole be excited by mental shock or any undue bodily exertion, when irregularity and increase of impulse, with some slight sharpness of the sounds, take place. The first sound may suggest, rather than have, a sharp ringing tone; while the second is prolonged.

(2) With respect to errors in *rhythmical action*, separately considered, it must here be noted that the chief and characteristic errors may be classified under the distinct heads of irregularity and intermittence. Irregularity may be in the force or in the frequency of one or more beats, and presents the many varieties which a want of normal uniformity may suggest; the minute and particular enumeration of these is rather satisfying to curiosity than instructive. It is sufficient to say that every variety of irregular frequency may occur; while, with certain beats, force may be increased or diminished. Sometimes there appears to be a kind of order in rhythmical disorders, that is, short series of varying irregularities may regularly succeed each other; there may be a fluttering or trembling, or that vibratory or vermicular motion to which the term 'thrill' has been given. True intermittence is not so frequent as irregularity; but when intermittence does occur, it is generally associated with irregularity. These disturbances may be only momentary or of long duration, slight or considerable; but, however this may be, their character is determined by the irregularity of the systole, or the prolonging of the period of intermission.

The physical examination of this form of functional disorder shows no marked peculiarities, excepting those of systolic irregularity. To the ear is revealed irregularity in the recurrence and duration of the sounds, from the slightest appreciable pause to the most rapid and confused trembling, with very manifest alterations in tone and pitch. The sounds generally are intensified, the first sound being sometimes heightened to the extent of a sharp knock; whilst the second, save in intensity, is not materially altered. In extreme cases there may be so much ventricular irregularity as to induce in place of sounds an ill-defined fremitus; and so much force as to produce a metallic ringing, with a rubbing murmur on the systole. Thus the impulse of the heart, which in health is rarely appreciable, and its friction never, respectively become so to the touch and to the ear; and the abnormal sounds may exist to such an extent as to entirely obscure the first sound.

Occasionally there is met with an appreciable rhythmical disturbance in the pulse, which is not found to exist in the heart—*false intermittence*. The heart only indicates irregularity of power; and as there is occasional failure of force in the already weak systolic contractions, the impulse is not communicated to the artery at the wrist. These false intermissions accompanying irregularity most frequently occur when the heart is oppressed by flatus in the neighbouring viscera, or is excited by injurious articles of diet, as tea, or by the use of tobacco, &c. The sensation communicated to the patient is that of a disagreeable flutter or 'tumbling over' of the heart, which tends to alarm, although habit may to a certain extent ameliorate the terror.

Rhythmical irregularity occasionally appears as a normal condition, having a life-long existence. Some cases are marked by an extension of the pause, with unsteadiness of the systolic impulse; others by its apparent extinction, so that there exists a rapidity of beats defying all analysis. There is in these cases usually a small weak heart, with systolic impulse devoid of energy. Both these classes of cases present the remarkable feature of losing much of their distinctive irregularity when under the influence of a febrile attack; the slow pulse becomes quicker and more steady, the rapid one less frequent and more distinct; but the feeling is, nevertheless,

not so comfortable as when the heart's action is in its state of normal irregularity.

(3) Functional disorder occasionally assumes the form of either increased or of diminished *frequency*, while the force and rhythm remain normal. Each of these conditions may be congenital and proper to the individual, or may be the result of abnormal influences. The functionally fast beat is generally induced by other diseases, as fever, diabetes, tuberculosis, &c., and is indicative of injury to normal innervation. The slow and drawling beat is generally met with where the nerve-power is healthy, but the heart itself is weak or fatty; or there is a perverted innervation under the influence of digitalis, aconite, or injury to the ganglionic system—a blow in the epigastrium offering a familiar example.

Inorganic murmurs are frequently heard in functional disorders of the heart, and more especially in those cases of hæmic disorder where the systolic impulse is increased, with rhythmical irregularity. These murmurs have the special characters usually attached to such sounds. They are systolic, basic, and chiefly heard in the præcordial region, with conduction in the course of the great vessels. There is no apex-murmur; but at the apex, synchronously with the murmur, the first sound is clearly defined, with a metallic ringing sound. The tone of these murmurs is musical, cooing, soft, of low pitch; the seat is in the aortic valves, and, as a rule, they are always accompanied with palpitation: this palpitation may be persistent, while the murmurs are not so. It is remarkable how large may be the amounts of blood drained from the system, and the frequency of the discharges, provided there be no diseased condition of the blood itself, without inducing the presence of a murmur. But under these circumstances, though there be no murmur, the first sound is usually flapping in character, and the second ringing in tone. The murmurs in chlorosis and spanæmia, and, when they occur, in ichorrhæmia and leukæmia, have their seat for the most part in the pulmonary valves, and are not traceable in the course of the larger arteries; they are also generally associated with the venous hum to be heard in the jugular veins.

Complications and Sequelæ.—The several functional disorders of the heart are often complicated with other diseases—many external to the heart, and some of the heart itself. The more prominent of the former are disorders of the nervous system and of the blood. Many of these have been already referred to. For the most part, those associated with a perverted innervation are examples of irritability, and exhibit rhythmical disorder, with pain. Hæmic diseases induce the simpler forms of palpitation; anæmia, gout, and dyspepsia induce palpitation with rhythmical disorder; spanæmia and chlorosis induce all these disorders, with murmurs superadded. The diseases of the heart with which functional symptoms of disorder are often found complicated are mainly degenerations of the walls, or valvular diseases. In all these cases the amount and urgency of the functional heart-disease is no indication of the urgency of the disease with which it may be complicated.

Are there any distinct morbid states or other sequelæ traceable to functional disorder of the heart? This may be a difficult question to answer dogmatically. Doubtless frequent and prolonged attacks of functional disorder are seen to occur without inducing any such. On the other hand, the long continuance of functional disorder is often marked by a depreciation of mental and bodily vigour. More specific organic changes are generally found to be due to some one or other of the diseases with which the functional disorder has been in its course associated.

Diagnosis.—In order to make a correct diagnosis, the first consideration is to ascertain the entire absence of organic disease; and, if it be present, whether it is adequate to cause the full amount of the symptoms exhibited. Supposing this to have been done, if the agitation of the heart is not only excessive, sudden, and apparently increased in strength, even to violence, but has often the features of spasm rather than the calmness of rhythmical order; while the sounds are *pari passu* increased in sharpness and intensity, and diffused over a larger area than is proper to them; and the pulse does not partake of the simulated force of the heart—the presence of an excited functional impulse may be assumed. The concurrence of some symptoms usually associated with organic disease, as dyspnœa or even apnœa and œdema, may, as has been shown, be due to the presence of chlorosis. So also where there is a deficient impulse, if the heart have its normal position and dimensions; if the sounds though weak be natural in tone and quality, in the absence of any abnormal physical disease, it may be concluded the cause is functional only. The same may be said of rhythmical irregularities. When any of these symptoms are associated with hæmic murmurs, the character of the murmur, its seat, and its persistency must be considered in connection with the absence or the presence of hæmic diseases. The symptoms of each of these several forms of functional disorder have been so fully described that there is no need to repeat them here. It must, however, be always borne in mind that the absence of the physical signs of disease is not always conclusive of there being no structural lesion, for there may be lesions, and important ones too, that do not yield evidence of their existence. The occurrence of the secondary changes, the immediate result of various congestions, is often an indication that the heart-symptoms are due to the presence of organic disease; still it is not always so, for congestions of the lungs and liver, and œdema, may be the consequence of spanæmia or of other morbid conditions of the blood. Hence, when these are present, the symptoms exhibited by a disordered heart may not be due to structural disease; and the same may be said of the effects of muscular exercise and of position, for either or both of these may distress if there be present any anæmic condition or an intercostal neuralgia. Nor, on the other hand, does the occasional subsidence of urgent symptoms, so frequently the case in functional disorder, absolutely affirm the conclusion that there is no organic disease; for occasionally in the latter the normal rhythm and force of the heart may

reassert themselves; but then in these cases there remain the other characteristics of the organic affection. Frequent examination and an accomplished experience will generally lead to a just diagnosis.

Prognosis.—The prognosis of functional disorders of the heart, for the most part, is favourable. Where there are baneful constitutional tendencies, or complications with other diseases, the prognosis must not, however, be always so considered. In the leucophlegmatic temperament the paroxysms may be severe and abiding, and generally distressing to the nervous system. If the symptoms be so urgent as to distend the right heart, the liver may become loaded, and dropsy may ensue. In this temperament mental shocks may induce palpitation, irregularity, and syncope, whence may ensue not only permanent heart-affection and eventually disease, but even immediate death. When functional disorder is the concomitant of scurvy or anæmia, the prognosis is not always favourable. Still in the young and middle-aged there is good chance of ultimate recovery; for if these diseases be subdued the functional disorder subsides. When occurring in the aged, or in those having a constitutional tendency to hypochondriasis, or when associated with organic diseases, or excited by inflammations of the endocardium, a less favourable prognosis must be given. Functional rhythmical irregularity, for the most part, does not indicate danger, but it may do so if associated with some obscure structural lesion. Nevertheless, cases of simple functional disorder, so severe as apparently to indicate an immediately fatal termination, prove, for the most part, manageable, and result in a restoration to health. The freedom of the heart from all agitation and other indications of disease, before and after an attack, is due to its being a normal and uninjured organ; and though liable during an attack to the morbid influences of spasms and congestive loading, it still may be a healthy organ. This holds whether the paroxysms be short or prolonged, occurring rarely, or frequently recurring. They are distressing but not dangerous.

Treatment.—Treatment should have reference primarily to the paroxysm, and then to its exciting causes, the indications being, first, the mitigation of the symptoms; and, secondly, the prevention of their recurrence.

Treatment of the paroxysms.—Towards the former, it should be ascertained, where possible, whether the attack be essentially due to irritability in the heart itself, or whether it have its origin in some co-existing excentric cause. The constitutional tendency and the exciting causes should be well considered; for the treatment of apparently similar attacks under the widely opposite causes of a plethora or an anæmia must be varied accordingly. Slight cases subside of themselves; but in more persistent attacks, for the most part, relief is obtained by warm carminatives or stimulants, or by antispasmodics, as ammonia, camphor, ether, assafœtida, musk, valerian, or sumbul. Where irritability of the heart itself is the cause of the attack, it is generally best met by sedatives, as opium, hyoscyamus, hydrocyanic acid, and in some cases digitalis. If the attack be due to derangement of the stomach, as from the presence of the gouty acids, an alkali may be useful. In extreme cases, and where head-symptoms supervene, the extraction of a small quantity of blood by leeches or venesection may be useful. The mental or moral treatment is of the greatest moment. A confident and cheering prognosis conduces to recovery, and prevents the nervousness which exhausts and tends to prolong the disorder.

Treatment between the paroxysms.—The paroxysm being allayed, it is then well to examine carefully into the state of health, so as to ascertain if there be any of those disordered conditions which may probably have been its exciting cause. Dyspepsia is to be relieved, the liver is to be set right, the uterine functions are to be restored to regularity, loaded bowels relieved, plethora subdued; spanæmia and chlorosis strengthened into health, exhaustion compensated for, and debility counteracted; and the over-worked must seek renovation in travel and cheerful recreation. In persons prone to these disorders many precautions should be observed. The young and the plethoric must avoid extremes of diet and exercise; the food should be moderate in quantity and unstimulating in quality; and exercise should be unfatiguing, and chiefly taken in the open air. Hot and ill-ventilated rooms, and the postponement of sleep by late hours, should be especially avoided. A careful mental discipline should be observed; and this must be sought in a healthy exercise of the brain, and restraining, by a well-ordered intellectual culture, the tendency to vain imaginings and emotional passions. The constitutionally nervous and irritable in mind must sedulously avoid exciting situations, as well as exhaustion by overwork. The sluggish and hypochondriacal must resist the temptations to inaction, seeking to overcome these tendencies by exercise; by cold bathing, more especially by means of the shower-bath; and, if the bowels be confined, by the judicious use of aperients. As all the varieties of functional disorder of the heart are peculiarly under the influence of a morbid will, it becomes of the first importance that the medical attendant should generally encourage and cheer; and as soon as careful investigation has satisfied the requirements of a just prognosis, further investigations by the stethoscope should be avoided. Empirical investigations tend to prolong the disordered action, and perhaps so to impress the imagination as to forbid recovery.

Thomas Shapter.

HEART, Hæmorrhage into the Walls of.—Synon.: Cardiac Apoplexy.

Definition.—Extravasation of blood into the substance of the heart.

Ætiology and Pathology.—Blood is extravasated into the substance of the heart in various pathological conditions, but as these are described under their respective headings, it will not be necessary in this place to do more than refer to them.

Rupture of the heart is the most frequent origin of hæmorrhage into the walls of the organ.

The blood in these cases may be derived from the cavity of the ventricle, and forced between the muscular fibres at each contraction. More rarely, a partial rupture of the wall may occur, unconnected with the cavities, and hæmorrhage take place into the seat of the lesion from one of the coronary vessels or their branches, constituting what has been called *cardiac apoplexy*. In both classes *fatty degeneration* is generally the cause of the rupture.

The formation of false consecutive *aneurism of the heart* may be attended with hæmorrhage into the walls; an abscess, blood-cyst, hydatid-cyst, or gumma having burst or made its way into one of the cavities.

The *coronary arteries* may be the source of the hæmorrhage; for instance, in rupture of coronary aneurism; in cases of cancerous ulceration of their walls; and in embolism or thrombosis of their lumen, leading to infarction.

Ecchymosis of the heart is a form of hæmorrhage belonging to a different category. It is generally met with in association with parenchymatous degeneration of the heart, for example in the acute specific fevers; with that form of fatty degeneration which is produced by certain poisons, such as phosphorus and arsenic; and with other pathological states in which ecchymoses occur in the viscera generally, as in purpura and scurvy, and especially in cardiac and pulmonary disease.

In cases of non-fatal hæmorrhage into the walls of the heart, the blood undergoes the changes usual in extravasations, and gives rise to the collections of pigment-particles which are sometimes found between and upon the muscular fibres; to blood-cysts; or to collections of puriform matter.

Hæmorrhage into the myocardium possesses no special clinical relations.

J. Mitchell Bruce.

HEART, Hydatid-Disease of.—A considerable number of cases have been recorded, in which hydatids, in the wider sense of the term, have been found in the human heart. According to Dr. Cobbold, 3·5 per cent. of all cases of hydatids in man occur in this situation.

Anatomical Characters.—Hydatid-cysts of the heart are either simple or multiple, the latter being the more common of the two forms. They are situated in the myocardium of either side of the heart; but tend naturally by enlargement to project either into the pericardial sac or into one of the cardiac cavities, in the form of a prominent cystic tumour. In this condition they have generally been found *post mortem*; but it is probable that in other cases the parasite may undergo degenerative changes in the heart, as in other organs, without its existence being suspected during life or discovered after death. In other instances, the hydatids rupture or are dislodged from their seat in the cardiac wall—either inwards or outwards, or in both directions at once. In the first event, the parasite or its contents or fragments become impacted in the cardiac cavities or orifices, or give rise to embolism of the great vessels or of a distant branch. Rupture of a cyst into the pericardial sac causes pericarditis; and rupture both internally and externally has given rise to hæmopericardium.

Hydatids of the heart are frequently associated with the same disease in other viscera. The appearance and structure of the entozoon do not require to be described here. *See* Hydatids.

Symptoms.—In several cases of this disease, the subjects have died suddenly during exertion, or, as in a case recorded by Dr. Wilks, after a hearty meal. These persons were not known to have suffered previously from symptoms referable to the heart. In other instances, the ordinary phenomena of chronic cardiac disease were present, including endocardial murmurs; but it is not certain that these were always due to the presence of the hydatids in the heart. A sudden fatal termination will be the result of internal rupture and embolism, or of hæmopericardium, as described above.

Diagnosis.—Hydatid-disease of the heart does not appear to have ever been suspected during life. Cardiac symptoms and signs, or sudden death, occurring in an individual known to be suffering from hydatids of other viscera, would suggest that the heart was also affected.

Treatment.—The disease cannot be said to have any special interest therapeutically.

J. Mitchell Bruce.

HEART, Hypertrophy of.—Synon.: Fr. *Hypertrophie du Cœur*; Ger. *Hypertrophie des Herzens.*

Definition.—Hypertrophy of the heart, in a wide acceptation of the term, may be said to express an increase in the size and weight of the organ, due to an excessive development of some one of the constituent elements of its walls. In the sense in which it is generally used, however, hypertrophy of the heart signifies an excessive development of the muscular substance only.

Such hypertrophy may be regarded as a conservative process; and is not intended to include those changes in the size of the heart in which the connective and fatty tissues are in excess.

Varieties.—The varieties of hypertrophy of the heart were first carefully described by M. Bertin in 1811, who demonstrated that the change in hypertrophy is the result of an increase of nutrition. He described three forms, which most succeeding writers have referred to, namely:—(1) *Simple Hypertrophy*, in which the parietes of the compartments are thickened, the cavities retaining their natural dimensions; (2) *Hypertrophy with Dilatation* (*Excentric Hypertrophy*), in which the cavities are increased in capacity, while the parietes are either of natural or of augmented thickness; (3) the so-called *Concentric Hypertrophy*, or *Hypertrophy with Diminished Cavities*, in which new material was supposed to be added, chiefly in the interior of the ventricular walls. Cruveilhier and Budd pointed out that the condition called concentric hypertrophy is the result, not of hypertrophy, but of a powerful contraction of the organ suddenly arrested, as it were, by death. Budd found that the hearts of persons who had died a violent death presented this so-called concentric hypertrophy; but that such hearts became relaxed, and showed the normal size of cavities and thickness of walls, after maceration. Roki-

tansky and Bamberger acknowledge the rarity of concentric hypertrophy, but think it does sometimes occur. It is said to have been found in the right ventricle in some cases of congenital malformations. Hypertrophy may affect only one compartment of the heart, or more than one, but the organ is seldom enlarged throughout. The ventricles are much more frequently hypertrophied than the auricles, and the left ventricle more frequently than the right; but the right auricle more frequently than the left auricle—which last shows the change very seldom.

Ætiology and Pathology.—The heart being a muscular organ, whatever calls forth increased frequency and force of its action induces hypertrophy of its muscular tissue. The great causes of this hypertrophy are certain obstructive conditions in the circulatory apparatus, which will be noticed in detail. But many circumstances might be enumerated as *predisposing* causes. Thus, males, from the nature of their occupations, are twice as prone to cardiac hypertrophy as females. In advanced age degenerative vascular changes are apt to induce this result.

Dr. Quain (*Lumleian Lectures*, 1872) has classified the *exciting* causes of hypertrophy under three heads:—*nervous*, *mechanical*, and *nutritive*. 1. Amongst *nervous* causes are those emotional conditions that produce frequent palpitation, and prolonged mental excitement or strain. The immoderate use of strong coffee, tea, or spirituous liquors might come under this head. 2. Amongst *mechanical* and physical causes are all those obstructive conditions to be afterwards specially examined. Violent athletic or other exercises, which notably accelerate the contractions of the heart, or produce excessive blood-pressure, may be mentioned here. It has been pointed out that great muscular exertion with the arms is specially prone to cause hypertrophy, as in the case of hammermen, &c. Prolonged working in a bent or constrained position is also mentioned as a cause. In fact, any prolonged impediment to the free action of the heart, or to the onward current of the circulation, tends to cause hypertrophy of the heart. Thus, in addition to valvular lesions, pericardial adhesion is an important cause. Diseases of the vessels, by diminishing their elasticity and increasing the friction, displacements of the heart, and deformities of the chest or spinal column, by twisting or constricting the aorta, are all causes of some obstruction to the blood-current. The heart becomes enlarged in pregnancy—but resumes its ordinary size by involution—as the womb itself does. A very important cause of cardiac hypertrophy is chronic Bright's disease. Aneurisms also sometimes induce hypertrophy, for the physical reason that the resistance encountered by a liquid flowing through a tube is increased by the presence of any abrupt dilatation and contraction of the calibre of the tube. Conditions of the lungs associated with persistent obstruction to the passage of blood through them (emphysema, asthma, phthisis, compression from hydrothorax, &c.) may induce hypertrophy of the right side of the heart. Hypertrophy also follows upon dilatation, because additional force is required to propel the larger volume of blood, apart from any valvular lesion. So mere plethora may tend to cause hypertrophy, which also ensues upon the distension of the cardiac walls which results from myocarditis. 3. With regard to the *nutritive* causes of hypertrophy of the heart, the state of the local nutrition and the nutritive quality of the blood have both to be taken into account. Rich nitrogenous food, and the use of ferruginous medicines, will favour hypertrophic changes. With the increase of the muscular structure there is proportional enlargement of the coronary arteries, so that the hypertrophied organ has an increased blood-supply.

The most important *conditions of obstruction* connected with cardiac hypertrophy are the following:—(*a*) *Stenosis of the aortic valves* is a common cause of hypertrophy of the left ventricle. The opening is not only narrowed, but is also rendered more rigid, and thus increased force is necessary to propel the blood. Along with the valvular lesion there may also be, especially in advanced life, a loss of elasticity and a roughening of the inner coat of the aorta from degenerative changes—conditions which increase the mechanical strain upon the left ventricle. (*b*) *Aortic regurgitation* often induces so great enlargement of the left ventricle, from hypertrophy and dilatation, that the heart in such cases merits the name *cor bovinum*. The back-flow of blood increases the intra-ventricular pressure, tends to dilate the cavity, and calls forth augmented efforts of ventricular contraction. (*c*) *Aortic aneurism* is usually instanced as a cause of cardiac hypertrophy, and we gave above the physical explanation of this result. But, as a matter of fact, many cases of aortic aneurism have been recorded not accompanied by cardiac hypertrophy, though some degree of this change is usually expected. Of course, other tumours, by pressing upon any of the great arterial trunks, may induce cardiac hypertrophy. (*d*) *Chronic Bright's disease* (contracted kidney) is a very important cause of left-heart hypertrophy, the hypertrophy being often of the purest type, without dilatation. This change is the result of the great increase of blood-tension produced by the resistance offered to the blood in the small arteries through the whole body, as well as in the kidneys. (*e*) As the result of *mitral stenosis*, the left auricle becomes somewhat thickened and dilated; and the further backward blockage of the blood produces pulmonary engorgement, and hypertrophy with dilatation of the right-heart. (*f*) Similar results follow the more common lesion—*mitral incompetency*. Blood regurgitates at each ventricular systole into the left auricle, which has thus to sustain the ventricular impulse in addition to the pressure from excessive fulness. Hypertrophy and dilatation of the left auricle, engorgement of the lungs, and hypertrophy with dilatation of the right-heart, are the natural consequences. Indeed, hypertrophy of the right ventricle is almost always associated with dilatation, and the double change is, in almost every case, consequent upon pulmonary obstruction, which may be caused by primary changes in the lungs themselves (see *g*), but is far more frequently secondary to left-heart disease (mitral lesions). (*g*) In *emphysema*, *fibrosis*, and *consolidated* or *compressed conditions of the lungs*, the impediment to the pulmonary circulation induces hypertrophy with

dilatation of the right ventricle. *Diseases* of the *pulmonary orifice* are very rare; so, too, is *tricuspid stenosis*. (*h*) But *tricuspid regurgitation* is common as a result of dilatation of the right ventricle; and this, in its turn, causes dilatation, usually with considerable hypertrophy, of the right auricle. General systemic venous obstruction follows upon right-heart blockage; and Hope says that venous retardation may work backwards through the capillaries to the minute arteries, the consequent increased resistance in which may induce left-heart hypertrophy.

Anatomical Characters.—The fundamental anatomical change in cardiac hypertrophy is an increase of the proper muscular tissue of the heart. There is no growth of new tissue different from the normal heart-muscle; there is simply an increase in the number of muscular fibres in all respects similar to those normally occurring in the organ. Along with the hypertrophy of the muscular tissue, there may be also more or less increase of the connective tissue between the muscular bundles; and this fibrous hyperplasia may be excessive, as Dr. Quain has pointed out, constituting a so-called 'false hypertrophy,' in which the colour of the cardiac walls varies from the natural to a light grey hue. There may be hypertrophy of only one part of the cardiac walls, abnormal thinning being found in other parts. The organ may be greatly enlarged from general dilatation, without any notable thickening of the walls; but the capacity of the chambers should always be carefully noted in estimating the degree of hypertrophy, as there may be a greatly augmented *extent* of wall, although its actual thickness seems normal. Simple hypertrophy is nearly always the first condition, preceding hypertrophy with dilatation. The greatest cardiac enlargements result from left-sided hypertrophy. Some examples of *cor bovinum* have attained the enormous weight of 40 oz. The wall of the left ventricle may become thickened to one or even one-and-a-half inches, instead of the normal six or seven lines; and the thickest part is usually about the middle of the ventricles. The interventricular septum is not so liable to hypertrophy as the rest of the ventricular parietes. The right ventricular wall may be thickened to the extent of one inch, instead of the normal two-and-a-half lines, and its greatest thickness is at its base. The columnæ carneæ of the right ventricle are even more liable to hypertrophy than the wall. In dilatation with hypertrophy the columnæ carneæ become stretched and attenuated. The substance of an hypertrophied left ventricle can generally be torn with ease, whilst that of an hypertrophied right ventricle is usually tough and leathery. The auricular walls are rarely thickened to more than twice the natural thickness, and are almost always dilated considerably if hypertrophied at all. In marked hypertrophy, the heart presents a change of configuration, becoming more globular, and having the apex tilted up. If the enlargement is mainly on the right side, the sphericity of the organ is a marked characteristic, and its long diameter has a tranverse direction in the chest. Of course, other pathological conditions, as valvular lesions, or the results of endocarditis or of pericarditis, may also be present. In true hypertrophy the coronary arteries become enlarged. There may sometimes be found accumulations of fusiform involuntary fibres, which have not developed into the higher state of striped fibres.

Symptoms and Signs.—Precise physical signs are all-important in establishing a diagnosis in cardiac enlargements, and it is always expedient at once to ascertain which chamber or chambers is or are affected. It must not be forgotten that simple hypertrophy may exist without producing symptoms attracting the attention of the patient, and that there is a natural tendency to some degree of cardiac hypertrophy with the advance of age. *Dyspnœa.*—In moderate hypertrophy without complication, there is usually easy and natural breathing when the patient's body and mind are at rest. But mental excitement or bodily effort at once induces more or less of temporary dyspnœa. In some cases the due expansion of the lungs may be mechanically impeded by the increased volume of the heart. In excentric hypertrophy with dilatation, more especially when the right cavities are thus affected, pulmonary congestion and œdema are very usually present, and then marked dyspnœa is a prominent and distressing symptom. *Cough.*—In simple hypertrophy there may be an occasional dry irritating cough, and in young phlethoric women a wheezing cough may be complained of. In right-side enlargements when pulmonary obstruction and dropsical effusions supervene, cough is, in most cases, a very frequent and painful addition to the other sources of discomfort to the patient. *Hæmoptysis and other hæmorrhages.*— Hæmoptysis from capillary engorgement is common, being generally active and sudden. Niemeyer points out that, in left-heart hypertrophy, there is often active distension, and sometimes rupture, of the branches of the bronchial arteries. In left hypertrophy, too, the cerebral arteries are specially liable to give way. In right-side enlargement with pulmonary obstruction, the blockage may influence the vessels of the liver and the portal system generally, so as to produce hæmatemesis or melæna. Epistaxis may also be due to cardiac enlargement. *Palpitation* is a common symptom in all organic diseases of the heart, and is often very marked in cardiac enlargements. The least excitement, bodily or mental, may induce a greater or less degree of this symptom. Especially in excentric hypertrophy with dilatation, most distressing paroxysms of palpitation are apt to occur from time to time. Besides bodily and mental excitement, other conditions, such as indigestion, flatulence, or an overloaded stomach, readily call forth this symptom. When there is much dilatation, the palpitation may be irregular and intermittent, and is then more particularly a very alarming symptom. *Pulse.*—In simple hypertrophy the pulse is stronger, fuller, tenser, less compressible than natural, and *dwells* longer under the finger, the hypertrophied walls requiring more time for contraction, and contracting with greater force than normal. When dilatation relatively exceeds the hypertrophy there is diminished strength, but more fulness, and sometimes marked slowness of the pulse. In aortic obstruction with left hypertrophy the pulse is strong, incompressible, small, and sustained.

In aortic regurgitation it feels as if liquid balls passed under the finger. In mitral obstruction it is frequently small and irregular. In mitral regurgitation it is irregular in size (not necessarily in rhythm). In enlargement of the right ventricle the pulse, as a rule, is small, weak, and perhaps intermittent or irregular. When atheroma of the vessels is associated with cardiac hypertrophy, the pulse is bounding. In the mere hypertrophy of old age it is full and slow, but not very incompressible. Certain *cerebral symptoms* ought to be mentioned in connection with the other more direct signs of cardiac hypertrophy. A feeling of fulness, or perhaps of throbbing, may be felt in the head after great muscular exertion or mental excitement. In pronounced cases there may be headache, ringing in the ears, vertigo, muscæ volitantes, and disturbing dreams. The bright and shining, or perhaps the blood-shot, condition of the eyes, is an indication of the hyperæmia of the cerebral vessels.

Hypertrophy of the Left Ventricle.—Simple hypertrophy of this portion of the heart does not usually produce much disturbance of respiration, but palpitation is a prominent symptom, and cerebral complications are, as we have seen, by far most frequent in this form of cardiac change. On *inspection*, the præcordium sometimes shows a bulging, more especially in young subjects, whose sternal cartilages are less resistant. Walshe says there may be some convexity of the cardiac region from the third to the seventh cartilages, and that the interspaces are rendered wider, but do not bulge. In simple hypertrophy the area of impulse may be seen to be enlarged, and to be located more to the left and lower down than normal. On *palpation* the apex-impulse may be felt to be greatly augmented in force, and to extend perhaps over the fourth, fifth, and sixth interspaces. When there is very great hypertrophy of the left ventricle, without pericardial adhesion or much dilatation, the apex-beat may be felt, powerful and well-defined, even in the seventh or eighth intercostal space. Dr. Walshe describes the sensation as a slow heaving, or a pushing forward as if against an obstacle. The duration of the heaving impulse is in proportion to the degree of hypertrophy. The impulse is often strong enough to visibly move the bed-clothes, and even to raise the head of the auscultator by the impact against the stethoscope. Of course a larger portion than usual of the heart's surface impinges against the chest-wall. With coexistent valvular lesions, a vibratory jarring sensation may be felt on palpation; and with pericardial adhesions the impulse may be a sort of jogging motion.

In hypertrophy *with dilatation* the impulse is less powerful, but is seen and felt over a wider area than in simple hypertrophy. The contractions are felt more like sharp blows or shocks, and the vibrations are conveyed to greater distances, in some cases extending to the top of the chest-wall. With great dilatation the pulse may be very slow, weak, and compressible. On *percussion*, the areas of both the superficial and the deep cardiac dulness are found to be increased, especially towards the left. In excessive hypertrophy with dilatation, the dulness may extend from the upper border of the third rib down to the eighth rib, and from an inch to the right of the sternum to the anterior axillary line. Dulness may also be detected in the left back. Emphysema and possible consolidation of the lungs must be borne in mind in marking out the area of cardiac dulness. On *auscultation*, the systolic sound is less clear and defined than normal in simple hypertrophy; it is prolonged in proportion to the degree of hypertrophy, and is muffled in character, as the muscular sound is excessively pronounced, and obscures that of the auriculo-ventricular valves. When there is much hypertrophy, the first sound may be of a metallic character. The post-systolic silence is shortened, and the second sound is loud. When there is dilatation with hypertrophy the first sound is more audible and distinct, and the second sound is louder.

Hypertrophy of the Right Ventricle.—In enlargements of this ventricle, *inspection* may reveal a rounded smoothness of the epigastrium, with perhaps some bulging of the ensiform and lower left costal cartilages. The apex-beat may be seen to be very diffused, extending towards the tip of the ensiform cartilage. Facial lividity is frequently seen; and jugular pulsation may be observed when there is tricuspid regurgitation. *Palpation* over the lower part of the sternum detects an impulse, which feels as if immediately under the hand, and wants the heaving character of the impulse of a hypertrophied left ventricle. Epigastric pulsation is often very pronounced. The liver-pulsation in such cases may result either from venous regurgitation, or from right systolic action exerted through the diaphragm. On *percussion*, the inferior line of dulness is found to extend lower down and farther towards the right than normal, sometimes reaching an inch or more beyond the right sternal edge. The dulness may be continuous with that of the liver. On *auscultation*, the first sound is more distinct than natural, and seems quite superficial. The second sound is also louder, and its reduplication is not uncommon.

Hypertrophy of the Auricles. — It is always difficult to speak very definitely of the condition of the auricles during life. They are never hypertrophied without being also dilated, and such states are uniformly connected with lesions of the auriculo-ventricular valves. Dulness due to an enlarged *left auricle* may extend up to the second left intercostal space; that due to an enlarged *right auricle* may be found in the third and fourth interspaces at the right sternal edge. Jugular pulsation may be found along with right auricular enlargement, which itself can hardly ever occur without an abnormal condition of the right ventricle.

Complications and Sequelæ.—Simple hypertrophy of the heart may go on quietly for a long time, just balancing the obstructive influence, and giving rise to no other form of disease. But when there is dilatation as well as hypertrophy, then palpitation, dyspnœa, venous congestion, and serous effusions are the ordinary results. Diseased conditions of the arteries may occur simultaneously, or may be induced by the long-continued additional strain put upon them

by a hypertrophied heart. Cerebral hæmorrhage often occurs in connection with an hypertrophied left ventricle, as in Bright's disease; although there are very frequently other factors, besides the mere excessive propulsive power of the heart, in the production of apoplexy. Pulmonary and general congestion and œdema are the usual attendants of mitral lesions with right-side enlargements. Pulmonary hæmorrhagic infarction (the so-called 'pulmonary apoplexy') generally results from embolism of the branches of the pulmonary artery, and takes place in connection with right-side enlargement. Sanguineous exudation in the tract of the bronchial mucous membrane may occur in left-heart hypertrophy. Persons suffering from cardiac hypertrophy are apt to be gravely affected by acute febrile diseases, because the resultant acceleration of the heart's action increases the embarrassment of the organ. Of course, hypertrophied cardiac walls are subject to the fatty degenerative changes described elsewhere. As has been alluded to already, the chief result of right-side dilatation is obstruction to the venous return. The hepatic circulation and the portal system generally are, in particular, rapidly overfilled, the whole venous system being ultimately affected. The kidneys likewise suffer. The natural results, in addition to characteristic changes in the chronically congested organs, are serous effusions into the cavities and subcutaneous areolar tissue.

Diagnosis.—An extended area of dulness; displacement of the apex-beat; and a slow, heaving systolic action, with augmented force of impulse, are the chief diagnostic physical signs of cardiac hypertrophy. In *young and thin people* the last of these signs may seem to be present, but the accompanying conditions readily exclude hypertrophy, especially the non-extension of the cardiac dulness. An *emphysematous left lung* may mask hypertrophy when present; and *lung-consolidation* might, though only for a moment, suggest it when absent. In *pericardial effusion* the triangular shape of the area of dulness, with the apex of the triangle upwards, is a distinctive feature; there would, moreover, be the history of an acute disease, with lancinating pain, dyspnœa or suffocative sensations, and other symptoms not found in mere enlargement of the heart. *Pleuritic effusion* or *aneurism* would be still more readily discriminated. The differential diagnosis between left-heart and right-heart enlargements has been sufficiently discussed in speaking of the symptoms and signs. *Dilatation* as distinguished from hypertrophy, is characterised by the feebleness and diffuseness of the apex-beat, which may even be quite imperceptible; by the great irregularity and intermittency of the heart's action; and by the general signs and symptoms of a feeble circulation.

Prognosis.—Simple, uncomplicated hypertrophy, as in the young, and in athletes, is not incompatible with long life, if the cause be removed in time. According to the extent and degree of complication, whether in the form of valvular lesions or co-existent pulmonary disease, the prognosis will be unfavourable. When the cardiac change is itself producing secondary lesions, as degenerations of the arterial coats, when dilatation is advancing, and when there is Bright's disease, the prognosis becomes very unfavourable.

Treatment.—Hypertrophy being in itself a conservative change, protective from worse results, the primary object is to remove, if possible, the cause of the hypertrophy. To aim merely at reducing the hypertrophy, irrespectively of its cause, as by lowering the nutrition, would gravely favour the worse evil of dilatation. General therapeutic principles, and the morbid conditions accompanying the hypertrophy, must therefore be carefully attended to. All mental and bodily exertion which excites the circulation must be scrupulously avoided. All alcoholic stimulants should be interdicted, and no more wine allowed than such as may seem to benefit digestion. The diet should be carefully selected, nitrogenous food being generally necessary. The digestive organs must be sedulously looked after, not only because good nutrition is very important, but also because flatulence and dyspepsia directly embarrass the heart's action. Mild saline and aloetic aperients should be given. Diuretics will be necessary if there is a tendency to dropsy, and in all cases great attention must be paid to the removal of congestion when it affects important organs, and the restoration of their functions when affected, more especially of the liver and the kidneys. When there is great excess of cardiac action, direct cardiac sedatives, as digitalis, hydrocyanic acid, conium, and belladonna, are called for. When there is dilatation and feebleness of texture with the hypertrophy, iron and digitalis are the chief remedial drugs.

J. R. Wardell.

HEART, Inflammation of.—Inflammation of the heart may affect either the lining membrane, or the substance or walls of the organ; and the subject will be best discussed under the separate heads of *Endocarditis* and *Myocarditis*. Inflammation of the investing membrane of the heart is described in the article Pericardium, Diseases of.

I. Endocarditis. Synon.: Fr. *Endocardite*; Ger. *Endocarditis*.

Definition.—Inflammation of the lining membrane of the heart.

Inflammation of the endocardium may be either acute or chronic. The acute form alone will be discussed here; chronic endocarditis being referred to under the head of Heart, Valves of, Diseases of.

Ætiology.—Endocarditis generally occurs in association with acute rheumatism; less frequently with the other acute specific febrile diseases, such as scarlet fever, measles, erysipelas, pyæmia and septicæmia—including puerperal fever; and much more rarely with typhoid fever and variola. Occasionally it is observed in the course of pregnancy, and after parturition; in acute and chronic Bright's disease; and in syphilis. Wounds and other injuries of the heart, such as rupture of the valves, may also lead to endocarditis; and local inflammation of the endocardium is frequently the result of the unnatural contact of one part of it with another during the cardiac revolution, as, for example, by growths from the walls or valves, or by unnatural blood-

currents. It also occurs in chorea, perhaps from the last of the causes just enumerated.

Age is an important predisposing factor in the ætiology of acute endocarditis, the occurrence of which as a complication of acute rheumatism is certainly most frequent in young subjects, and declines as age advances. Women are also more subject to rheumatic endocarditis than men.

The localisation of the endocardial inflammation appears to be determined chiefly by pressure and tension, rather than by any peculiarity of the membrane itself, or of the blood in contact with it. Thus the left ventricle is almost the sole seat of the disease in the adult, and the right ventricle in the fœtus; whilst endocarditis is rarely seen beyond the boundaries of the valves, that is, the parts most subjected to strain. In the same way, chronic endocarditis is usually due to increased pressure within the heart, as in chronic Bright's disease, and in conditions that entail prolonged severe strain upon the valves during exertion. A similar cause is at work in pregnancy.

In a certain number of instances of the *ulcerative* form of endocarditis, the origin of the disease has been traced in connection with the presence of an ulcerating surface or foul wound in some part of the body, most frequently in the female genital organs *post partum*.

Anatomical Characters.—Inflammation of the endocardium affects chiefly the valves and the chordæ tendineæ, and especially the lines of contact or the surfaces of the valves exposed to the force of the blood-current. The endocardium of these parts at first appears slightly swollen, velvety, soft, and of various shades of red; whilst the lines or points of contact of the valves present warty enlargements of a similar character, which are known as 'vegetations.' As the process advances, the inflamed areas become more opaque and firm; and a fibrinous deposit is entangled with their surface. When the endocarditis has gone thus far, resolution is probably rare; and the most common result is what is known as 'chronic valvular disease,' that is, that the affected parts are left opaque, puckered, and thickened by growth of connective tissue, whilst the vegetations develop into firm fibroid or even cartilaginous-like bodies. As a consequence of these changes, the valves may become much altered in size and shape, and the ostia contracted and irregular, so that the mutual adaptation of the parts is greatly disturbed. Other results of inflammation are not uncommon in the progress of endocarditis, such as adhesions between the neighbouring structures, and ossification or calcification of the altered tissues. Laceration of the valves and rupture of the chordæ tendineæ during the stage of diminished resistance, ulceration, suppuration, and the formation of aneurism are rarer events.

The microscopical appearances of inflammation of the endocardium correspond with the naked-eye characters. In the early stages, the proper tissue of the endocardium is swollen by hyperæmia, œdema, and the appearance between its fibres of a number of leucocytes; the latter rapidly multiply to form the bulk of the vegetations; and the surface presents various thicknesses of deposited fibrin, which in its turn may become organised. The further development of the new cells into connective tissue gives rise to the opacity, thickening, and puckering of the valves, and to the formation of permanent vegetations.

The effects of these changes upon the functions of the valves and their appendages are described in the article Heart, Valves of, Diseases of. Particles of fibrin, and even of the vegetations are occasionally detached from the endocardium, and give rise to embolism.

In a special form of the disease, which is known as *ulcerative endocarditis*, the morbid appearances are at first not unlike those described above as characterising the early stage of the ordinary affection; but the process pursues a different course, and becomes mainly destructive in its nature. The edges or surfaces of the valves then present spots or patches of loss of substance, having an eroded appearance, and an irregular base, covered with granular matter, and fringed by vegetations. These diseased areæ may advance to actual perforation, burrowing abscess, or aneurism. Microscopically examined, the patches prove to be areæ of ulceration, and the granular matter of their base has been found by Virchow and others to contain organisms, which were seen at the same time in the capillaries of distant parts of the body.

Symptoms.—The symptoms of endocarditis are inseparable from the symptoms of the disease with which it is associated, and the diagnosis of it is made almost entirely from the presence of physical signs. Thus fever probably precedes the advent of endocarditis, in every case; and it cannot be said that the simple uncomplicated disease in any respect affects either the pyrexia or any other element of the same. Local symptoms are almost equally rare, unless the endocarditis leads to serious lesion of the cardiac valves. As long as these remain sound, and the disease is acute and does not involve deeper structures, pain in the heart, præcordial distress, syncope, shortness of breath, and other symptoms of heart-disease cannot be said to occur at all frequently in endocarditis. The cardiac contractions are necessarily increased in frequency; and palpitation and dyspnœa may occur on movement. It is otherwise when the inflammation has lasted so long as to render the valves incompetent, or to obstruct the orifices; or when the myocardium is attacked, and dilatation ensues. The symptoms just enumerated then make their appearance, as well as those of secondary involvement of the lungs, of the circulation, and of the system generally.

Ulcerative endocarditis, unlike the ordinary form of the disease, is manifested by severe and striking symptoms, although amongst these the phenomena of cardiac inflammation are comparatively subordinate to those of general infection. It is on this account that ulcerative endocarditis has only recently been definitely recognised as a distinct form of disease, the condition of the endocardium *post mortem* having apparently been disregarded in the presence of serious lesions of the other viscera, of the blood-vessels, and of the blood itself. Commencing with a sudden rigor, in the course of acute rheumatism, during the puerperal state in women, or in a case of chronic

valvular disease, ulcerative endocarditis either resembles a simple continued or typhoid fever from first to last, or assumes a markedly pyæmic character. In the former case, gastro-enteric symptoms and splenic enlargement may be strongly marked; whilst in the second case, vomiting and diarrhœa, jaundice, albuminuria, and various eruptions, with pyrexia of a pyæmic or remittent type, are prominent phenomena. In both forms the case steadily progresses towards a fatal termination. A loud systolic murmur is generally present from the first, and may point to the heart as the primary seat of disease; but in ulcerative endocarditis, as in simple endocarditis, special local symptoms are rare.

Physical Signs.—The physical signs of acute endocarditis are—increased extent and frequency, with variable strength, of the visible and palpable impulse; moderate increase in the area of præcordial dulness; and various alterations in the cardiac sounds. At the beginning of endocarditis, the first sound at the left apex is frequently heard prolonged and hollow, or muffled; and, as the process advances, this alteration of character may gradually pass into a murmur, which is at first indistinct, but afterwards well-formed. If the aortic valves are affected, the second sound may similarly lose its characters, become dull, and finally be converted into, or be complicated with, a murmur. The most frequent murmur in acute endocarditis is mitral systolic; aortic murmurs are decidedly less common; and mitral præsystolic murmur is very rare. Various inorganic murmurs may appear, and either disappear or continue during the course of the disease.

Complications.—Endocarditis is itself always a complication of the diseases previously mentioned. Myocarditis and pericarditis may be correctly regarded as complications of endocarditis, when the inflammation begins in the lining membrane of the heart. According to some authorities, clots may form in the heart in endocarditis, and give rise to very urgent symptoms (*see* Heart, Thrombosis of). Embolism may arise from detachment of fragments of coagula or vegetations; and this condition, and the development of pyæmic symptoms are essential elements in the course of the ulcerative form of the disease. Congestion or inflammation of the lungs frequently occurs in association with endocarditis, and so may albuminuria.

Course, Terminations, and Sequelæ.—The course of simple endocarditis is very uncertain, and varies with the course of the original disease with which it is associated, as well as with the complications. If acute rheumatism be checked in a few days, inflammation of the endocardium may be expected to be also arrested. In a considerable number of cases, however, endocarditis passes on to chronic valvular disease. For example, the late Dr. Sibson found that seventeen out of seventy cases of endocarditis with mitral systolic murmur ended in established valvular disease, and less than a half of the cases with diastolic basic murmur.

Simple endocarditis very rarely proves fatal; but the ulcerative form is believed to be uniformly so in the course of a few days, or it may be weeks. On the other hand, simple endocarditis, being by far the most common cause of valvular disease of the heart, leads indirectly to much suffering, and, as a rule, ultimately to death.

Diagnosis.—The diagnosis of endocarditis depends upon the discovery of the development of an endocardial bruit of organic origin during the course of one of the diseases already named. From functional murmurs the bruits of valvular inflammation may be diagnosed under different circumstances—first, by their locality, which is most frequently the mitral area; secondly, by their time, diastolic or præsystolic murmurs being always organic; and, thirdly, by their association with pericardial friction. The special characters of inorganic murmurs are described elsewhere. Chronic valvular disease may be diagnosed from acute endocarditis by the presence of cardiac enlargement and other well-known signs; of marked cardiac symptoms—especially pain and dyspnœa; and of visceral complications. Much more difficult of diagnosis is acute endocarditis occurring in the course of chronic valvular disease. Change of the character of the murmur, if this have been observed previously, may lead to the suspicion of fresh inflammation, but cannot establish the diagnosis of its existence, which may not be discoverable. The diagnosis of the precise seat of endocarditis on the various valves is discussed in the article Heart, Valves and Orifices of, Diseases of.

It is often impossible to diagnose *ulcerative* endocarditis from typhoid fever or pyæmia respectively, according to the form that it assumes; unless the ætiology of the case, the precise character of the pyrexia, and the occurrence of metastases be very carefully regarded, along with the development of a murmur at one or more of the cardiac orifices, and possibly of pericarditis.

Prognosis.—The immediate prognosis of acute endocarditis is generally favourable, and may be safely estimated by the absence of local symptoms. The remote prognosis, on the other hand, as regards both life and health, is exceedingly bad, inasmuch as endocarditis so frequently ends in chronic valvular disease. The probability of this result of acute inflammation of the valves is frequently difficult or impossible to estimate. A feeble, soft, and smooth murmur, or a feeble and grave murmur, is much more likely to disappear than a loud extensive well-defined bruit. The probability of the disappearance of diastolic basic murmurs may be best estimated by the absence of the effects produced by aortic incompetence upon the heart and vessels.

Treatment.—The treatment of acute endocarditis has to be discussed under three heads, namely, first, preventive; secondly, immediate; and thirdly, subsequent treatment.

a. Preventive treatment.—When a patient is suffering from any disease which may become complicated with endocarditis, and especially if he be suffering from acute rheumatism, every means must be adopted to prevent, as far as possible, the occurrence of this complication. Thus, in acute rheumatism it is all-important to check at once the intensity of the disease by recourse to salicylic acid or its salts, and other means; for experience shows that endocarditis, when it does occur in acute rheumatism, generally

makes its appearance within the first week. Again, the duration of the primary disease must be curtailed if possible, inasmuch as endocarditis, although it generally appears early, may possibly occur at any period of the disease. Thus the medicinal preventive treatment of endocarditis in these cases resolves itself into the medicinal treatment of acute rheumatism. Another point of equal importance in the prevention of endocarditis is diminution of the cardiac activity. We have seen that the pressure within the heart is an important factor in the causation of endocarditis; and this pressure must be reduced by diminishing the work to be done by the heart, without lowering the cardiac power. Rest must therefore be enforced in the recumbent posture —an end which is usually already secured by the presence of acute rheumatism of the joints. The personal comfort of the patient must be zealously attended to, and pain relieved, so that restlessness and irritability may be avoided, and for this purpose carefully selected anodynes may be necessary. Stimulants must be cautiously ordered; the bowels should be regularly and fully moved; and the various secretions are to be kept as active as possible.

b. Treatment during an attack.—When endocarditis has actually made its appearance, the various means just insisted upon must be enforced as rigorously as before, so as to diminish the intensity of the inflammation, and to limit the extent of surface involved. Rest is still of the first importance. The medicinal treatment of the original disease—especially of acute rheumatism—must be persevered in. Local applications to the præcordium, such as cataplasms, or, in cases of sthenic inflammation, leeching, are often of great service. The administration of stimulants will require the greatest care; excitement of the heart, on the one hand, being avoided, and, on the other hand, digitalis, ammonia, or alcohol being employed, if symptoms of cardiac distress supervene. Equal caution is demanded in the use of anodynes which may be indicated to relieve distress connected with the joints; and local applications, such as cotton-wool, poultices, aconite, and belladonna, should be employed in preference to opium, chloral, and other cardiac depressants.

In *ulcerative* endocarditis, quinine in large doses, and salicylic acid are the remedies which appear to promise most success; and all the ordinary measures for support in fever must be persevered with.

c. Treatment after an attack.—When the primary disease, such as rheumatism, has subsided, and the restoration of the various functions indicates that convalescence has commenced, the physician must not forget the state of the endocardium that has recently been inflamed, which is probably still in a condition of great physical weakness, and the seat of new cell-growth. Instead of urging the patient to sit up and walk about under these circumstances, as must have been frequently done under the 'rival methods' of treating acute rheumatism, we should recommend a very gradual return to exercise, and the most jealous avoidance of actual exertion. There can be no question that, at this stage, rest for several weeks is of more importance than medicinal treatment. At the same time various tonic and other remedies should be employed.

II. **Myocarditis.** —Synon.: Carditis; Fr. *Myocardite*; Ger. *Myocarditis.*

Definition.—Inflammation of the walls of the heart.

This disease may be either acute or chronic; but the latter form, which is attended with the formation of fibroid tissue in the myocardium, is described under the head of Heart, Fibroid Disease of. Pyæmic inflammation of the substance of the heart also constitutes such a special form of disease that it is treated separately (*see* Heart, Pyæmic Abscess of). Acute myocarditis alone, therefore, has to be considered in the present article.

Ætiology.—A certain amount of myocarditis is sometimes associated with acute endocarditis and pericarditis, and depends upon the same causes; the most frequent being acute rheumatism. In a small proportion of cases, rheumatic myocarditis appears to occur independently of inflammation of the lining or of the covering membrane. In the great majority of recorded cases of localised myocarditis ending in abscess, the cause of the disease was altogether obscure. It has been observed most frequently in males, and before the twenty-fifth year of life. Exposure to cold, severe exertion, and local injury are mentioned amongst exciting causes, but with questionable correctness.

Anatomical Characters.—Acute inflammation of the myocardium generally involves the connective tissue as well as the muscular fibres; but in a few instances the latter alone have been found affected, constituting so-called *parenchymatous myocarditis.*

The ordinary form of the disease is characterised by the appearance of leucocytes between the muscular fibres of the heart. In one class of cases, the inflammation is moderate in intensity but diffused in extent, affecting one or more layers of muscle underlying the endocardium or pericardium, which are also inflamed; in another class of cases, the inflammation is more active, and proceeds to the formation of abscess, whilst it is, as a rule, comparatively localised.

In the first or diffused form, the myocardium, as it is seen through its inflamed covering, appears of a mottled opaque buffy colour, and is somewhat swollen and softened. The microscopical characters consist chiefly in the appearance of leucocytes and inflammatory effusion in the intermuscular connective tissue; swelling, opacity, nuclear proliferation, and rupture of the muscular fibres, followed by fatty degeneration and atrophy of the same; and the ordinary inflammatory changes of the vessels of the part. Beyond this stage, unless the case prove fatal, the diffused form of myocarditis passes into a chronic condition: and it ends either in fibroid disease with a moderate amount of atrophy, by development of the inflammatory products and atrophy of the affected fibres; in fatty degeneration; in calcification; or in cardiac aneurism.

Suppuration of the heart, on the other hand generally takes the form of swollen yellowish-white patches or abscesses, surrounded by dirty-red or ecchymosed tissue, boggy or pulpy to the

finger, and containing on section a small quantity of variously-coloured puriform matter, consisting of pus and muscular débris. In the same cases a great part of the walls of the heart may be in a condition of parenchymatous degeneration; and in some recorded instances the whole of the cardiac tissue is described as infiltrated with pus. Abscesses resulting from acute localised myocarditis are generally very small, varying from the size of a pea to that of a nut. They may either burst externally into the pericardial sac, or internally into one of the cavities or through one of the valves, leading to pyæmia, and to the formation of an acute cardiac aneurism; or the pus may make its way both externally and internally, and lead to fatal hæmorrhage into the pericardium. In other cases the pus undergoes the usual changes, and becomes inspissated or cheesy, or calcification takes place.

In both forms of interstitial myocarditis the left ventricle is most frequently the seat of inflammation.

Symptoms.—The principal symptoms of acute rheumatic myocarditis are restlessness and urgent dyspnœa; severe pain and distress referred to the præcordium; and palpitation, which gradually passes into irregularity and greatly increased frequency, and finally into complete cardiac failure. The pulse corresponds. The countenance is anxious and pale, or cyanosed. The mind is fearful and distressed at first, and delirium frequently supervenes before death, especially in young subjects. Vomiting is not uncommon.

The *physical signs* are generally associated with those of endo- and peri-carditis; but when uncomplicated may be described as—violent cardiac impulse at first, which rapidly loses in strength and regularity, while it increases in frequency; a somewhat increased area of cardiac dulness; and short sharp sounds, afterwards becoming duller and more feeble.

When these symptoms and signs make their appearance, they generally run their course rapidly, and end in death. In a small number of cases they as rapidly disappear.

The symptoms of localised suppurative myocarditis leading to abscess are not unlike those just recorded. There are the same distressing symptoms locally, with restlessness and anxiety, passing on to delirium, and ending in collapse. Rigors have been observed in some cases; and a peculiar pustular eruption on the skin in other cases. The physical signs also are not special; excepting that a murmur may be suddenly developed by rupture or perforation of part of the wall or of a valve.

The majority of cases of abscess of the heart prove fatal by asthenia; but the other terminations of abscess mentioned above will be attended by their respective symptoms, and the possibility of sudden death is especially to be noted.

Diffuse *parenchymatous* myocarditis is clinically known only as a cause of sudden death.

Complications.—The complications of acute myocarditis have already been sufficiently indicated, such as, first, ætiologically, pericarditis, endocarditis, acute rheumatism, and other causes of these forms of inflammation; and, secondly, pathologically, rupture of the cardiac walls or valves, acute cardiac aneurism, hæmopericardium, embolism, and septicæmia.

Course and Terminations.—The course of acute interstitial myocarditis, as already stated, is generally rapid, extending from a few hours to eight days in different cases. Death occurs, in the great majority of cases, from the effects of cardiac failure, if the inflammation be extensive or proceed to suppuration. The formation of acute aneurism by internal rupture, the production of pericarditis by external rupture, and other complications will variously modify the progress and termination of cardiac abscess. Simultaneous rupture both externally and internally causes sudden death.

Diagnosis.—The diagnosis of acute myocarditis is extremely difficult. Occurring in connection with acute rheumatism, it has to be distinguished from endo- and pericarditis. The absence of murmur and of the characteristic signs of pericarditis, along with symptoms of cardiac failure and severe local phenomena, such as pain, distress, dyspnœa, and finally collapse, should generally serve to establish the diagnosis of inflammation of the walls of the heart. It cannot be said that cardiac abscess has ever yet been diagnosed; but the careful consideration of all the points in the case, and the sudden development of a murmur indicative of rupture of portion of the wall, or of a valve, may hereafter ensure greater success. In the event of the development of the last-named sign, and of septicæmia or embolism, cardiac suppuration would have to be carefully diagnosed from ulcerative endocarditis. In children, acute myocarditis has to be distinguished from acute meningeal inflammation, an object which may be effected by the careful observation of the signs and symptoms connected with the heart.

Prognosis.—The prognosis of myocarditis, when it is either so extensive or so intense as to give rise to unequivocal symptoms, is extremely unfavourable.

Treatment.—The two principal indications of treatment in acute inflammation of the substance of the heart are to support and strengthen that organ, and to relieve the pain and distress. Local anodynes, especially in the form of the preparations of belladonna and poultices; and stimulating 'counter-irritants,' such as mustard cataplasms, will conduce to fulfil the second indication. Such relief is the first essential, if rest is to be secured. The patient must be spared the very smallest exertion. Food must be given in small quantities, and be easily digestible and highly nutritious; the bowels must be kept open; and the flow of urine should be as free as possible. Alcoholic stimulants will be urgently called for; and palpitation may be regarded as an indication of the necessity for these, as much as weakness of the impulse. Digitalis, ammonia, and other cardiac stimulants should be given cautiously, at the same time, so as to strengthen the cardiac action, whilst diuresis is encouraged.

J. Mitchell Bruce.

HEART, Malformations of.—Synon.: Fr. *Affections Congénitales du Cœur;* Ger. *Missbildungen des Herzens.*

Classification and Description.—The car-

diac anomalies of development may be classed as follows:—

I. Those dependent on arrest of the process of development at an early period of fœtal life, so that the organ retains its most rudimentary form, the auricular and ventricular cavities being still single or presenting only slight indications of division, and the primitive arterial trunk being retained, or the aorta and pulmonary artery being very imperfectly evolved.

II. Those in which the defective conformation occurs at a more advanced period, when the auricular and ventricular partitions are already partly formed, and the aorta and pulmonary artery more or less completely developed. Such are the cases in which, with imperfect separation of the ventricles and auricles, the arterial or auriculo-ventricular passages are constricted or obliterated, and the origins of the aorta and pulmonary artery are misplaced.

III. Cases in which the development of the organ has progressed regularly till the *later periods of fœtal life*, so that the auricular and ventricular septa are complete, and the primary vessels have their natural connections, but in which there are defects which prevent the heart undergoing the changes which should ensue after birth: such are the premature closure of the foramen ovale, the non-development of the ductus arteriosus, or the occurrence of slighter sources of obstruction at the arterial or auriculo-ventricular passages or in the course of the aorta.

IV. Cases in which there is some irregularity in the formation of the valves, or in the connections with the vessels, or in the vessels themselves, which, though not immediate sources of obstruction, may become so during the progress of life, so as to lay the foundations of subsequent disease.

I. Cases of the first class are of very infrequent occurrence, and are the more rare according to the extent of the imperfection. The first case of simply biloculate heart was placed on record by Mr. Wilson, in the *Philosophical Transactions*, in 1788, and the specimen is preserved in Dr. Baillie's museum, in the possession of the Royal College of Physicians. The anomaly was found in the body of a child, which survived for seven days. From defect in the diaphragm, the heart lay in a sac on the upper surface of the liver; and the organ was found to consist of an undivided auricle and ventricle, and a single artery, evidently the primitive arterial trunk, which first gave off a vessel which furnished the branches to the lungs, and the vessels to the head and upper extremities. The coronary arteries arose by a common trunk from the aorta before its final division. Since the publication of this case, others have been placed on record illustrating the gradual advancement from the simple to the more complicated forms—the ventricle becoming more completely divided, the septum of the ventricles being more fully developed, and there being two vessels given off from the ventricle, though in some cases one of these may be abortive, or if there be only a single vessel, that being shown by the origin of the coronary arteries from its commencement to be really the aorta.

II. Of the second class, the examples which have been described are much more numerous. In cases of this kind the auricles and ventricles are fully formed, though the septa which divide them are incomplete, and there is usually more or less displacement of the origins of the primary vessels, so that the aorta more especially may come to arise partly or almost entirely from the right ventricle; or the points of origin of the vessels may be transposed, the aorta arising from the right ventricle, and the pulmonary artery from the left. Cases of the former description, in which the septum of the ventricles is incomplete, and the aorta misplaced to the right, are almost always found to coexist with some obstruction to the passage of the blood from the right ventricle, either (1) from smallness of the pulmonary artery; (2) from imperfection of the valves; (3) from constriction at the outlet of the right ventricle, or at the end of the conus arteriosus or infundibular portion of the ventricle; or (4) from constriction at the commencement of the conus or point of union between that portion of the ventricle and the sinus. A case of the second description was published by Sandifort, in 1777, and one occurred to Dr. Hunter in 1761, but was not published till 1763. The fourth form of obstruction, or that occasioned by constriction between the sinus and the infundibular portion of the right ventricle, has only recently been explained, though cases of the kind have for some years been placed on record. It is indeed probable that the existence of a very decided partition in this situation led to the idea entertained by some of the older pathologists, that the heart occasionally had three ventricular cavities. The abnormal septum is partly formed by hypertrophy of the muscular structure, and partly by the endocardium becoming thickened; and in some cases very decided obstruction is so caused. The defect is generally developed at an early period of fœtal life. The septum of the ventricles is therefore incomplete, the defect being at the posterior part, so that the aorta comes to arise from the sinus of the right ventricle, while the pulmonary artery takes its origin from the infundibular portion, which seems to constitute a distinct cavity. The heart thus, as pointed out by Mr. Grainger, bears an almost exact resemblance to the condition of the organ in the turtle. In the turtle there are two aortic ventricles and one pulmonic ventricle; the right aortic and the pulmonic ventricle being the analogues of the sinus and infundibular portion of the right ventricle, and being in connection, while the left aortic ventricle is distinct.

Much more rarely there has been found an entire obliteration of the orifice or trunk of the pulmonary artery, the first case of this description of anomaly having also been published by Dr. Hunter at the same time as the former case. Much more rarely the defect in the ventricle has been found in connection with obstruction or obliteration of the right auriculo-ventricular, the left auriculo-ventricular, or the aortic aperture. Where the septum of the ventricles is incomplete, the defect generally exists at the base, at the part which has been termed the *undefended space*—the space which intervenes between the contiguous sides of the left and posterior semilunar segments, where on the left side the muscle is

naturally deficient; and in this way a connection may exist between the left ventricle and right auricle or ventricle, either immediately above or below the right auriculo-ventricular opening. More rarely the septum between the left ventricle and the conus arteriosus of the right ventricle is defective; and still more rarely an aperture exists at a lower part of the septum. The portion of the septum dividing the left ventricle from the sinus of the right is termed by Rokitansky the posterior—that between the left ventricle and conus arteriosus, the anterior septum. With the defects now mentioned, the auricular septum may also be incomplete, or the foramen ovale may be still open, or the ductus arteriosus pervious. Indeed, when the pulmonary artery is much contracted or impervious, one or other of the former conditions necessarily exists, and the ductus arteriosus becomes the means by which the blood is conveyed to the lungs, though occasionally there are compensatory branches derived from the aorta or one of the large vessels also distributed to the lungs.

The transposition of the aorta and pulmonary artery also occurs at an early period of fœtal life. The first case of the kind recorded was related by Dr. Baillie in 1797; the specimen is figured in his plates, and still exists in the museum in the possession of the Royal College of Physicians. In this anomaly the septum of the ventricles is generally defective, and the two fœtal passages open, and the organ may indeed be very defective in conformation. The heart also is often misplaced in the chest. Another form of defect is that in which the descending aorta is given off from the pulmonary artery through the ductus arteriosus. This condition is apparently the result of imperfect development of the isthmus aortæ between the origin of the left subclavian artery and the point of entrance of the duct, so that an adequate supply of blood cannot be conveyed from the ascending into the descending aorta. Generally the condition coexists with defect of the septum of the ventricles, as in two cases formerly in the possession of Sir Astley Cooper, and now contained in the museum of St. Thomas's Hospital, described by Dr. Farre in 1814. In some instances of this kind the portion of aorta between the left subclavian artery and the duct is imperforate, and yet in others, as in a case related by Steidelle and referred to by Hein in 1816, there is no connection between the two portions of the aorta, the ascending part giving off the vessels to the head and upper extremities, the descending portion being wholly derived from the pulmonary artery. This form of defect is closely allied to the cases which are occasionally seen in after-life, in which there is constriction or obliteration of the isthmus aortæ beyond the left subclavian artery, the circulation being maintained through collateral channels.

III. The third class of cases consists in the premature closure of the foramen ovale; or the non-development or disappearance, at an early period of fœtal life, of the ductus arteriosus; or in diseased conditions of the valves, which prevent the heart undergoing the changes which should ensue after birth.

The first condition is of very rare occurrence. The first case recorded was related by Vieussens in 1715. In these cases the blood during fœtal life being all transmitted through the right cavities and the pulmonary artery and duct, those portions of the heart are unduly developed, while the left side of the organ becomes atrophied. In the second class of cases the heart is defectively developed, and the right ventricle gives origin to the aorta, and often also vessels are distributed from the aorta to the lungs, while the ordinary pulmonary artery may be very small in size, or may be entirely absent. In a case of this kind, described by Dr. Ramsbotham, the pulmonary artery is said not to exist; but by examination of the specimen preserved in the London Hospital Museum, the writer has ascertained that this is not correct. The artery exists as a very small vessel, but the scanty supply of blood to the lungs which it furnished was complemented by small vessels from the aorta. In cases which are not of uncommon occurrence, and may be classified with the malformations now spoken of, but which are closely allied to the next class, there exists some source of obstruction to the transmission of the blood from or into the right ventricle, which determines the imperfect closure of the foramen ovale, or the patency of the ductus arteriosus. The obstruction in these cases generally depends on disease of the pulmonic valves, or obstruction at the end or beginning of the conus arteriosus, or at the right auriculo-ventricular aperture.

IV. The fourth class of malformations consists of defects, of a slighter description, of the valves, or narrowing of the orifices, or of the isthmus aortæ.

The semilunar valves may be excessive or defective in number. The former condition probably does not materially interfere with the functions of the heart—the latter often does so, and especially when, as is very frequently the case, the valves become the seat of disease in after-life. If there be only two valves, one of them imperfectly representing two distinct segments, there is great liability to incompetence. If there be only one valve, representing three imperfect segments, obstruction is almost necessarily occasioned.

It is probable that the cases in which the tricuspid valve is found represented by a kind of membranous diaphragm, stretched across the orifice and perforated in the centre, and some of the so-called cases of button-hole mitral, are also of congenital origin.

It is not considered necessary in this article to refer to many examples of these different forms of malformation, or to allude to other of the less important deviations from the natural conformation of he heart. The subject will be found more fully treated of in the works of Dr. Farre[1] and Gintrac[2] and Freidberg,[3] in the papers of Dr. Chevers,[4] and in the writer's own work.[5] The more recently published cases also are ab-

[1] *On Malformations of the Human Heart.* London, 1814.
[2] *Observations et Recherches sur la Cyanose, ou Maladie Bleue.* Paris, 1824.
[3] *Die angebornen Krankheiten des Herzens etc.* Leipzig, 1844.
[4] *Collection of facts illustrative of Morbid Conditions of the Pulmonary Artery.* London, 1851, and *Medical Gazette*, 1845 to 1851.
[5] *Malformations of the Human Heart.* Second edition, 1866.

stracted in the treatise of Taruffi,[1] and numerous examples of different forms of malformation are given by Rokitansky.[2]

Mode of Formation.—It is probable that all the different forms of irregularity in the development of the heart are due to arrest of development, occurring at different periods of evolution, so that the heart retains the forms proper to it at such stages. The cause to which this arrest is to be ascribed can rarely, however, be traced in cases where the defect is great, such as those of biloculate heart, or where the vessels are transposed with or without very marked imperfection in the organ itself. These defects must be ascribed to the imperfect evolution of the double set of cavities, and of the pulmonary artery and aorta from the primitive trunk and branchial arches. In the less marked defects, however, the irregularity can often be traced to a source of obstruction to the transmission of the blood through one or other of the apertures or vessels. Such obstruction is much the most common in connection with the right ventricle and pulmonary artery. In cases of this kind the septum of the ventricles is deficient, so that the aorta arises wholly or in part from the right ventricle. Dr. Hunter, in the paper before referred to, when describing a case of obstruction of the pulmonic orifice with defect in the septum of the ventricles, suggested that the imperfection in the septum was probably caused by the pulmonic obstruction. Meckel, however, adopted the view that the primary defect was in the septum of the ventricles, and that the pulmonary artery became more or less abortive from being thrown out of the course of the circulation by the ready outlet afforded for the blood from the right ventricle into the aorta. The former view seems, however, to afford the more satisfactory explanation, and is in accordance with the almost constant occurrence of disease of the valves in these cases. According to the view of Meckel, the pulmonary artery should simply be small, as when the ductus arteriosus is absent, like the case of Dr. Ramsbotham before referred to, but such a condition is very rarely found. The excess in the number of the semilunar valves might seem to afford an example of redundant development, but this condition also probably depends on arrest of development; though, as we do not clearly understand the mode in which these valves are developed, it is impossible to express a very decided opinion as to the cause of the apparent excess.

Symptoms and Diagnosis.—There cannot generally be much difficulty in recognising a case of malformation of the heart during life. Not only in cases of a very marked kind is there generally a complete history of the condition of the subject during its short life, but the symptoms are also very characteristic. The child is very markedly cyanotic; the cheeks, lips, hands, and feet are excessively livid; the fingers and toes are clubbed; the nails are incurved; and the patient is liable on any excitement, or on exposure to cold, to attacks of dyspnœa, often followed by convulsions. There are also often present difficulty of breathing, cough, and expectoration of blood; with palpitation, and often pulsation of the vessels of the neck. If also there be any obstruction at or near the pulmonary orifice, there will be a harsh systolic murmur heard in the course of the pulmonary artery; and if there be a defect in the septum of the ventricles, the murmur will be heard probably also in the course of the aorta. Often there are unhealthy ulcerations about the fingers, toes, and anus or vulva. If the case do not attract notice till late in life, there will probably be less marked signs of obstruction to the circulation, and possibly they may be entirely absent, and there may be no history of the patient's previous condition. In cases of this kind the probability will be that if there is a murmur at the pulmonary artery there is some defect at or near the orifice of that vessel, with or without an aperture in the septum of the ventricles or an open state of the ductus arteriosus. The former condition is so rare as the result of disease in after-life, that if the signs point to pulmonic valvular disease, its congenital origin may safely be surmised. The open foramen ovale and ductus arteriosus could probably not be diagnosed with any certainty, though cases have occurred in which peculiar murmurs noticed during life were supposed to be so produced. It might be supposed that when so small a proportion of the blood is subjected to the influence of the air, as in some of these cases, the temperature of the patient would not reach the natural standard, but the most careful observation of the temperature of children labouring under congenital cardiac cyanosis has generally failed to detect any marked difference between them and other children of about the same age.

Cyanosis.—There are few subjects which have excited more discussion than the causes of Cyanosis or *Morbus Cœrulus*. Morgagni, in 1761, when describing the case of a girl who had obstruction at the orifice of the pulmonary artery with an unclosed foramen ovale, expressed the opinion that the general congestion was probably the cause of the remarkable lividity which had been noticed during life; and Dr. Hunter, in 1783, in describing a case of pulmonic obstruction with imperfection in the septum of the ventricles, ascribed the lividity to the intermixture of the venous and arterial currents of blood. These views have since received support from various writers. The view of Morgagni has been maintained by Louis, and that of Hunter by Gintrac. It has been very fully shown that there is no just and constant relation between the intensity of the cyanosis and the amount of intermixture, and indeed that very marked cyanosis may exist without any intermixture; while on the other hand in all cases of marked cyanosis there are present causes capable of producing great venous congestion. The writer is, therefore, of opinion that the evidence is very greatly in favour of the correctness of the views of Morgagni and Louis, that the cyanosis results from stasis of the blood, though probably other causes conduce to the intensity and peculiarity of discoloration. Thus, probably, the defect must be congenital, or, at least, of very long duration, so that the smaller vessels may become greatly dilated; the integuments must be thin, so as to allow the colour of

[1] *Sulle Malattie congenite, etc., del cuore.* Bologna, 1875.
[2] *Die defecte der Scheidewände des Herzens.* Wien, 1875.

the blood more readily to be seen, and lastly—probably also from the very small portion of the blood which can be subjected to the influence of the air—the whole mass is of an unusually dark colour, and so the intensity of the lividity is increased.

Duration and Terminations.—The duration of life in the subjects of the different forms of malformation varies greatly, according to the degree of the defect in the heart. In cases in which the organ presents a very rudimentary condition, life can only be prolonged for a few hours or days; while in the slighter forms of defect the patient may survive to puberty or to manhood or womanhood, or even to more advanced age. Thus, in cases of contraction of the pulmonary artery, without other defect in the organ, cases are on record in which patients lived to 44 and 63; when, with the pulmonic disease, the foramen ovale was unclosed, the subjects have reached 40 and 57. Where the septum of the ventricles was deficient, nine patients are stated to have lived to between 20 and 30. Where the ductus arteriosus was still open, patients lived to 13½ and 19 years; but of course these ages are the extremes, and by far the largest proportion of the subjects die much younger. When the pulmonic orifice or artery is impervious, but few patients survive for more than two years, but cases are on record in which 9 and 12 years of age were attained; the age being greater according to the facility afforded for the transmission of the blood from the right side of the heart, as when the septum of the ventricles was imperfect, than when the ventricles were completely separated.

Transposition of the aorta and pulmonary artery is a defect incompatible in any of its forms with the prolongation of life for any lengthened period. Four cases are, however, on record in which the patient survived to between 2 and 3 years of age—the imperfection of the septum of the ventricles tending in these cases also to the prolongation of life.

The most common causes of death in cases of malformation of the heart are affections of the brain and lungs, hæmoptysis, &c.; and, if the patient survive for a sufficient period, tuberculous affections. Notwithstanding the very great obstruction to the circulation, dropsical symptoms do not generally arise to any marked degree.

Treatment.—It is scarcely necessary to speak of the treatment of these cases. It must consist in protection against cold; in the maintenance of bodily and mental quiet; and in the use of a nutritious and easily digestible diet.

T. B. Peacock.

HEART, Morbid Growths in.— The various forms of morbid growth that have been met with in the heart may be thus enumerated in the order of their frequency:—1. Malignant disease; 2. Lymphomatous or lymph-adenomatous growths; 3. Non-malignant tumours; and 4. Cysts. Fibroid growths, syphilitic gummata, and tubercle, as well as hydatids affecting the heart, are discussed separately under their respective heads. Calcareous, cartilaginous, and osseous changes of the myocardium are noticed in the article Heart, Degenerations of.

1. Malignant Disease of the Heart.—Cancer, although the most common of the new formations found in the heart, is still very rare in this situation, and is a subject chiefly of pathological interest.

Ætiology.—Malignant disease of the heart is, with very few exceptions, always secondary; and the primary growth may have its seat in any part whatever of the body. Occasionally the heart becomes involved by continuity, the lungs and mediastinum being the seat of the primary disease. Cases have occurred at all periods of life, from infancy to old age; but at least one-half of the subjects have been in the middle period of life. The disease has been most frequently found in males.

Anatomical Characters.—Carcinoma, epithelioma, and sarcoma, including colloid cancer and melanosis, have all been found in the heart in different instances. Any part of the organ may be affected, and the right side appears to be more frequently invaded than the left; but the disease is generally multiple. The morbid growth generally presents itself at or upon either of the surfaces of the heart, rather than in the substance of the myocardium. In these situations there appear one or more masses of malignant disease, which are generally easily distinguished from the cardiac tissue around; and which possess the ordinary characters of such formations, according to their respective forms, encephaloid being the most common, and epithelioma by far the most rare. Any difficulty in the recognition of the disease is removed by section and microscopical examination. The extent of cardiac wall involved by the growth is sometimes great. When the masses of malignant disease project externally, they are frequently associated with pericarditis, either local or general. Prominent nodules in the interior of the heart may cause local endocarditis; and in other instances the valves and their appendages may be so involved that incompetence results. In very rare cases malignant disease of the heart proceeds to ulceration.

Symptoms.—Of thirty-six cases of malignant disease of the heart, the histories of which were collected by Dr. Quain, in thirty either there were no symptoms present, or they were not recorded. In one of the remaining six cases, the subject of the disease, a man of thirty-seven, in whose heart a single large mass of encephaloid cancer was found *post mortem*, had been subject to attacks of excruciating pain in the præcordial region, to dyspnœa, palpitation, and vomiting; and death occurred suddenly. Pain in the chest and oppression, not referable to other causes, are recorded in two other cases; and in the fourth there were anginal seizures. In cases of cancer of the heart spreading from the mediastinum or lungs, dyspnœa, cough, and pain are necessarily frequent symptoms.

With respect to the physical signs of malignant disease of the heart, tenderness on percussion over the præcordium (in association with local pain), pericardial friction, and endocardial murmurs due to involvement of the valvular apparatus in the new growth, appear to be the only phenomena that have been specially observed.

The disease naturally ends in death; and in

more than one instance this termination was sudden, and perhaps directly due to the affection of the heart.

Diagnosis.—This condition has probably never been diagnosed during life. The appearance of true cardiac pain, or of any of the physical signs just mentioned, in the course of a case of cancer, would, however, be strong evidence that the heart was secondarily involved.

Treatment.—The treatment of malignant disease of the heart is necessarily limited to the relief of any symptoms that may be present, and does not differ from the treatment of cardiac distress from other causes.

2. **Lymphoma of the Heart.** — Lymphomatous or lymphadenomatous growths have been met with in the heart in several cases in which the disease was general, but this affection of the organ cannot be said to have any clinical importance.

3. **Non-Malignant Tumours of the Heart.** These growths are also of purely pathological interest, and are amongst the very rarest of morbid appearances in connection with the heart. *Myomata* have been recorded as instances of this class of diseases. *Lipomata* lying under the endocardium are referred to in the article Heart, Fatty Growth on.

4. **Cysts of the Heart.**—The occurrence of true cysts in the myocardium (hydatids, abscesses, hæmatomata, and softening gummata being excluded) is doubtful.

J. Mitchell Bruce.

HEART, Palpitation of.—Synon.: Fr. *Palpitation du Cœur*; Ger. *Herzklopfen*.

Definition.—Abnormal movement of the heart, whereby the force of the systolic contractions is increased to such a degree as to give rise to a sensation of discomfort or distress on the part of the patient.

Ætiology.—The *immediate* or proximate cause of palpitation is an over-stimulation of the excitability of the muscular structure of the heart, induced by functional errors of the cardiac ganglia and of the vagus, or of those nerves which, proceeding from the ganglia of the great sympathetic, supply the heart. It is therefore a true neurosis. The disordered action of these nerves may be induced either directly or by reflex action; but in either case the phenomena as regards the heart are the same, namely, the morbid activity of a normal function, which must be here considered as independent of any accompanying organic lesion.

The *predisposing* and *exciting* causes of palpitation of the heart are various. The chief *predisposing* causes are to be found in the nervous and excitable temperaments; general debility; inanition; exhaustion, whether bodily or mental; early age; hysteria; venereal excesses; and in deterioration of the blood, as occurs in gout, scurvy, chlorosis, or spanæmia. Amongst the *exciting* causes may be classed violent exercise; mental shock, emotion, and all forms of sudden excitement of the nervous system; dissipation; injurious articles of diet; and dyspepsia.

Symptoms.—Palpitation may be found in the form of (1) a single action; or (2) a series of actions, which may become prolonged, and of such a character as to be esteemed chronic. The single abnormal beat not unfrequently occurs during a first sleep, and the patient is wakened by a consciousness of it. Sleep may then return, and the attack subside without other inconvenience; or it may be associated with a feeling of weight, fulness, anxiety, sinking, or even pain of the præcordia. More frequently, however, the attacks are prolonged and paroxysmal, recurring with an accelerated and uncertain frequency, and varying rapidity. In the patient the act of palpitation causes various and widely different sensations. There may be a mere occasional flutter, or a slightly increased action continuing for a time; or there may be increased action attended with great rapidity, and such violence that the heart appears forcibly to strike the chest-walls, diffusing its influence over the whole sternal region, and even at times agitating the whole body (a phenomenon probably due to an associated general nervous agitation); or the heart, again, may seem to the sufferer to rise, as it were, into the throat. With these several forms there may be the accompanying symptoms of choking—the *globus hystericus*; vertigo; tinnitus aurium; impaired vision, with a feeling of distension of the eyeballs; a copious secretion of pale limpid urine; a clammy coldness of the extremities; fear of death; partial unconsciousness; or actual syncope. Paroxysms such as these may be preceded by a somewhat prolonged state of cerebral disturbance, as evidenced by heat of brow and vertex, headache, and an inaptitude to think or regulate the thoughts; and as there is generally a self-consciousness of the abnormal action of the heart, the anxiety on this account serves to impress the mind with so much fear and inquietude, as to tend to increase and prolong the disorder that has induced them.

Physical Signs.—The physical examination of the heart shows the apex-beat to be normal in position, but diffused and much exaggerated in force. The area of dulness, as a rule, is not enlarged upwards, but it may be temporarily enlarged, under certain circumstances, towards the right side. The sounds, always exaggerated, at times become very much so, and usually with a sharp metallic ring. Occasionally a kind of remitting humming sound is superadded, and may be heard even by the patient; but this is never constant. Sometimes the sounds are heard over a great extent of surface; but this extent is no measure of their intensity, for they may not be loud, but abnormally clear and distinct only. Occasionally there is a pericardial rubbing accompanying the mitral apex-shock, simulating the friction-sound of pericarditis, but there is never true friction-sound. The basic second sound, more frequently than the first, presents the metallic ring. Sometimes it becomes lower-pitched and less clicking than in an ordinary paroxysm of palpitation; and may even, as also the first sound, so lose sharpness and abruptness as to assume somewhat of the character of a soft murmur. The aorta, carotids, and large arteries also throb, and have an excited impulse. The smaller arteries are not sensibly affected. The pulse at the wrist is often no indicator of the amount of action exhibited by the heart. Sometimes it has the character of being sharp and

jerking, without force ; or, should the right side of the heart become loaded with blood, it may be small and soft, and weak. On the subsidence of a paroxysm, the ventricular impulse may drop to its natural force and frequency, and the sounds be unaccompanied by any exaggerations. Nevertheless, though the attack may have subsided. there may be some slight irritability of the heart's action perceptible for some short time afterwards.

Diagnosis.—Though the diagnosis of palpitation of the heart in some cases may present difficulty, yet, in the absence of evidence of structural lesion, an increased impulse presenting the above distinctive characters may be assumed to be functional in its origin, and not dependent on any organic disease of the heart itself. We have, in fact, to do with an exaggeration, sometimes highly marked, of the natural nervous susceptibilities of the heart ; and this nervous increase of impulse, even when only slight, is usually more appreciated by the patient, more painful, and more a source of anxiety than is that attending organic disease, especially in its earliest stages.

Treatment.—The treatment of palpitation should in every case be directed to remedy or to remove the exciting cause of the attacks, and to render the nervous system less susceptible. In the simpler forms that which is prophylactic is all that is necessary. In more marked attacks general care, with quiet, may be sufficient ; or the administration of an alkali with warm restoratives. In the protracted and severer forms of attack, besides ether and ammonia, digitalis, aconite, colchicum, chloral hydrate, and the bromides may be occasionally resorted to.

T. Shapter.

HEART, Pyæmic Abscess of.—Definition. — Abscess of the heart occurring in pyæmia.

Ætiology.—Abscess of the heart has been most frequently observed in cases of pyæmia following acute necrosis of bone or diffuse periostitis, and less frequently after phlebitis, chronic or acute arthritis, urethral stricture, chronic abscess, and cancerous ulceration. In eleven out of fourteen cases, the histories of which were collected by Dr. Quain, the age of the patients was seventeen years or under; and twelve out of the same fourteen cases were males. In other words, pyæmic abscess of the heart has been most frequently found in cases following injury to a bone or to a joint in boys. In older subjects it has been associated with pyæmia secondary to one or other of the diseases just mentioned. In a few cases no primary disease was discovered.

Anatomical Characters.—Pyæmic disease of the walls of the heart has been most frequently observed in the left ventricle, towards the base and in the papillary muscles. In the great majority of cases, pericarditis co-exists, and very frequently endocardial inflammation also. The pyæmic foci are generally multiple ; and appear at first as small, slightly elevated, yellowish or buff-coloured, softened patches, projecting either on the external or on the internal surface of the heart, and covered with inflammatory deposit. On section, these patches either present an appearance of diffused yellowish softening, or contain one or more collections of dark dirty puriform matter, with ragged, ill-defined boundaries, as if formed by destruction of the discoloured tissue around, and varying in size from that of a pea to that of a pin's head.

Microscopically examined, the yellowish patches prove to be portions of the myocardium which are infiltrated with pus and granular matter ; the muscular tissue itself being in a condition of granular or fatty degeneration. The puriform material represents an advanced stage of the same change, consisting of granular mat ter and other muscular débris, blood, and frequently pus-corpuscles. The several stages of the pyæmic process have been found side by side in some cases ; and embola have been discovered in the branches of the coronary arteries, where they may have served as the foci of the abscesses. The walls of the heart are sometimes in a condition of softening throughout. Pyæmic abscess of the heart occasionally bursts ; and the contents either make their way into the left ventricle—producing cardiac aneurism, and perhaps giving rise to further embolism and pyæmic disease—or into the pericardial sac.

Symptoms.—Whatever the symptoms of pyæmic abscess of the heart may be, they have in recorded cases been completely obscured by the general symptoms of pyæmia, and by the local symptoms and signs of pericarditis. Thus, the patients are described as presenting a febrile, typhoid, or pyæmic appearance, an anxious look, dyspnœa, and præcordial pains ; pericardial friction has been generally discovered over the heart. Delirium probably occurs more frequently than in ordinary cases of pyæmia, but may be referable to the accompanying pericarditis. The *physical signs* found in these cases are chiefly those of acute pericarditis. Sometimes an endocardial bellows-murmur may be heard, due either to valvular lesion, or to the formation of an acute aneurism of the cardiac wall.

Course and Terminations.—The cases of pyæmia in which the heart has been found *post mortem* to be involved, have generally proved rapidly fatal, the patients dying from exhaustion. Rupture of the abscess in either direction may tend to accelerate the fatal termination ; but complete rupture of the wall in both directions, with sudden death from hæmo-pericardium, as in non-pyæmic abscess of the heart, does not appear to be on record.

Diagnosis.—In every case of pyæmia the physical condition of the heart should be regularly investigated ; and there should no longer be any risk of acute inflammation of the heart or pericarditis being mistaken for meningitis or simple delirium. Pyæmia with multiple arthritis and involvement of the heart is more difficult of diagnosis from ordinary acute rheumatism with cardiac inflammation ; and mistakes in such cases have not unfrequently occurred. The history of the case, including the evidence of a definite injury, however slight, is of the greatest value ; but a careful consideration of all the facts of the case alone can prevent mistakes. The only difficulty that remains in the diagnosis of pyæmic abscess of the heart is the determination of its

existence in the presence of pericarditis, which is rarely absent. For this purpose the facts of the ætiology of the case are more important than the symptoms; and especially the occurrence of an injury to the periosteum of a youthful subject as the original cause of the pyæmia. As a matter of fact, the symptoms, either general or local, appear never to have suggested the diagnosis of pyæmic abscess of the heart.

Prognosis.—If a diagnosis of abscess of the heart can be made in pyæmia, the only possible prognosis that can be given is one of speedy death.

Treatment.—The treatment of pyæmia affecting the heart cannot be said to differ in any important respect from that of ordinary cases of the disease (*see* Pyæmia). The accompanying pericarditis will call for local treatment.

J. Mitchell Bruce.

HEART, Rupture of.—The heart is liable to rupture from external injuries, and from causes acting from within. The latter are called spontaneous ruptures, and these only will be considered here. Spontaneous ruptures may affect either the walls or the valves. The latter form of lesion will be found discussed under the head of Heart, Valves of, Diseases of.

Ætiology.—Rupture of the walls may be said never to occur spontaneously when the heart is healthy. The following have been enumerated by different writers as the diseased conditions of the heart's walls that *predispose* to rupture:—a thin or atrophied condition, simple softening, a 'gelatiniform' condition of the walls, apoplectic or hæmorrhagic effusion into the walls, abscess, ulceration, and fatty degeneration. The writer finds from a table of 100 cases of rupture, the histories of which he has collected from different sources, that the heart had undergone fatty degeneration in 77; in 6 the walls were described simply as being softened; in 1 there was rupture of an aneurismal dilatation; in 1 there was bursting of an abscess; in 12 the heart is said to have been healthy in texture, or not to have been examined; but in most of these latter cases mention is made of the previous existence of endocarditis, or of changes in the coronary arteries, fully justifying the impression that there was disease of the texture of the heart.

The influence of *age* in relation to rupture of the heart can be distinctly traced. For example, of the 100 cases just referred to, 63 were above the age of sixty years. Arranged in decades, the cases stand thus:—2 were between ten and twenty; 1 between twenty and thirty; 3 between thirty and forty; 6 between forty and fifty; 13 between fifty and sixty; 33 between sixty and seventy; 24 between seventy and eighty; 6 were over eighty; and in 2 the age is not stated. With respect to *sex*, of 98 out of 100 cases in which it is mentioned, 54 were males and 44 females.

The *exciting* cause of rupture of the heart is usually some mental excitement or physical effort; but the accident may occur when the subject of it is at rest, or pursuing the ordinary avocations of life.

Anatomical Characters.—*Seat.* In 76 cases out of the 100 to which we have already alluded, the left ventricle was the seat of the rupture; and in 43 of these cases the lesion was in the anterior wall. The right ventricle was found ruptured 13 times, nine instances occurring in its anterior wall. The right auricle was ruptured seven times; the left auricle twice; and a rupture was found in the septum four times. These results correspond remarkably with those of other writers on the subject. Elléaume (*Mon. des Hôpit.*, 1858) in 55 cases found the rupture 43 times in the left ventricle, seven times in the right ventricle, three times in the right auricle, and twice in the left auricle.

On examining a heart in which rupture has occurred, the torn part is found to present different characters in different cases. The lesion may be *complete*, causing perforation of the walls; or it may be *incomplete*. In *complete* rupture the opening is sometimes barely sufficient to admit a probe, whilst in other instances it may be two or three inches in length. The rent is sometimes longer externally, and sometimes it is longer internally. There may be but one, or there may be more than one, rupture; and in the latter case the ruptures may or may not communicate with one another. In *incomplete* rupture the injury may be confined to the internal surface, or to the external surface, or it may occur in the substance of the walls. The edges of the rent are ragged, irregular, and sometimes ecchymosed. The irregularity of the edges is due to the manner in which the muscular fibres are torn, whether across or split longitudinally. This description refers more correctly to rupture in a heart that is the subject of fatty degeneration. The appearances are different when the rupture is secondary to an abscess, or to ulceration, or to certain other causes presently to be described. In such cases the lesion has been described as a rent, tear, ulceration, or perforation. The condition of the heart in the majority of cases of rupture has been already referred to in this article under the head of *Ætiology*. Ecchymoses are sometimes found in the vicinity of the lesion. The pericardium generally contains an effusion of blood, which often surrounds the heart with coagulum, leaving the sac filled with serum, to the amount, it may be, of thirty ounces, as in an instance which came under the writer's notice.

Mechanism.—Rupture of the heart is doubtless nearly always the result of a strain or of pressure acting upon the muscular walls. The walls of the healthy heart are sufficiently strong to resist any ordinary force to which they are exposed. But when they are softened by degeneration, or are very thin, as is sometimes the case in the auricles or the right ventricle, they may give way before the pressure to which they are exposed during muscular efforts or strains, or even in the ordinary action of the organ. Thus, when a part of the wall of the heart is weakened by softening or other cause, this spot may be, as it were, torn across by the contraction of the healthy fibres among which it is situated. Or again, when the walls of the heart are thick, it may be that the outer surface, being strained over the contents of a distended ventricle, as would be the outer surface of an overbent hoop

gives way, tears, and the opening gradually extends from without inwards. These facts enable us to understand why rupture is more frequent in the left than in the right ventricle. A further explanation is to be found in the fact that the left ventricle is more frequently than the right the seat of fatty degeneration, from causes elsewhere alluded to (*see* HEART, Fatty Degeneration of). There is yet another way in which softening leads to rupture. A softened spot occurs in the substance of the heart, and into it hæmorrhage takes place, constituting what is termed *apoplexy of the heart*. At times this hæmorrhagic softening may yield either externally or internally, and give rise to rupture. Lastly, the writer has seen more than once a small spot of softening with loss of substance occurring on the internal surface of the ventricular wall, most frequently in the left; this softening and breaking down of tissue gradually insinuates itself amongst the muscular fibres, until finally perforation of the outer wall of the heart occurs.

SYMPTOMS.—The symptoms of rupture of the heart may be described as those which are premonitory; and those which occur at the time of the accident. The former are such as indicate a diseased condition of the organ—namely, breathlessness on exertion, palpitation, more or less irregularity of pulse, and faintness. In some instances recorded these symptoms were so slight as hardly to attract attention; in others so severe as to cause intense suffering. In the majority of the cases noted in the table referred to, no mention is made of any preceding symptoms, death being sudden. In several cases it is distinctly stated that no symptoms preceded the fatal attack.

The occurrence of the lesion itself, when the patient has lived long enough to describe his sensations, has always been marked by intense cardiac suffering, more or less distress in breathing, restlessness, rapid and irregular pulse, faintness, pallor, coldness of the skin, sometimes vomiting, and by various nervous symptoms. When life is prolonged beyond a few minutes, there may be more or less intermission in the progress of these symptoms; but the whole attack is marked by anguish more or less severe. The duration of the attack itself from the first fatal seizure varies remarkably. In 71 out of the 100 cases alluded to, death was sudden, occurring within one or two minutes. One patient, however, lived eight days, 1 six days, 1 three days; 5 lived over forty-eight hours, 3 lived under twenty-four hours, and 19 under twelve hours.

The special symptoms indicative of a fatal seizure are, in addition to those already mentioned, severe præcordial pain, dyspnœa, vomiting, cyanosis, pallor, loss of consciousness, and convulsions. These symptoms, or some of them, were noted in 44 out of the 100 cases; and in 24 of these the patient lived for more than five minutes after seizure, and in some of the cases for more than twelve hours. These cases, doubtless, are instances in which the muscular fibres are torn apart layer by layer successively. In the other 20 cases the patient was seized with severe pain, and then expired; or with dyspnœa and some of the other symptoms mentioned above, and lived but a few seconds.

The *physical signs* of complete rupture having occurred, so far as can be ascertained, are merely —a greater or less amount of dulness in the region of the heart; the impulse diminished; the sounds muffled, distant, or imperfectly developed; and the pulse weak and intermittent.

COURSE AND TERMINATIONS.—The difference in the progress of the fatal malady depends much upon the seat of the rupture, on the size of the opening, and on the rapidity with which the extension of the laceration takes place. In the cases in which the septum is torn, there is no external hæmorrhage, and life is prolonged until the patient dies from disturbance in the functions of such an important organ as the heart. (*See* a case reported by Dr. Peacock, *Pathological Transactions*, vol. v.) The progress of the symptoms is also influenced by the direction and course of the rupture. If the torn fibres overlap from the inside or from the outside, the injury penetrates slowly through the cardiac wall, and the fatal progress is also slow. (*See* cases recorded by the writer in the *Pathological Transactions*, vol. iii., and also in vol. xii.; and a case by Dr. Peacock in vol. xvii. of the same *Transactions*.)

PROGNOSIS.—As far as is known, rupture of the heart is always fatal. Still it is possible that such an accident, owing to the small size of the opening, its incomplete character, and its occlusion by a coagulum, may not prove fatal. Numerous instances are recorded of severe wounds of the heart, the subjects of which have survived. Ollivier has collected 29 such cases, only two of which proved fatal within forty-eight hours, the others living from four to eight days. Cases are recorded in which persons have survived many years severe wounds of this important organ. These cases, however, differ from those of rupture in this particular, that they occur in the healthy organ, whilst spontaneous rupture occurs in the heart when it is seriously diseased (*see* HEART, Wounds of).

TREATMENT.—In the way of treatment of rupture of the heart little can be done. The patient's sufferings may perhaps be relieved by the hypodermic injection of morphia, or by the use of other sedatives. Perfect rest should, if possible, be maintained.

R. QUAIN, M.D.

HEART, Softening of.—This term was formerly applied to several conditions of the heart in which the consistence of the cardiac tissue was diminished, whilst the process to which it was due was obscure or anomalous. It is probable that under the name of softening of the heart there were especially included instances of acute myocarditis, parenchymatous degeneration, and fatty degeneration. In the present more advanced state of cardiac pathology, it seems desirable that the expression 'softening,' while retained to express a familiar physical condition, should cease to be employed as a classifying term—that is, to designate any specific anatomical state.

J. MITCHELL BRUCE.

HEART, Syphilitic Disease of.—Syphilitic disease of the heart is by no means a rare condition, having been found in a large number of instances in which the specific nature of the lesion was determined with certainty; whilst, in another series of cases, similar anatomical appearances were present, although the existence of syphilis was not ascertained. Syphilitic disease of the heart is therefore of much pathological interest; but it cannot be said that a great deal is known as yet with respect to its clinical history.

Ætiology.—There appears to be nothing of importance known as to the causes of the localisation of syphilis in the heart. The congenital as well as the acquired form of the disease has been met with.

Anatomical Characters.—This morbid condition presents two leading appearances *post mortem*. The first is the well-marked syphilitic *gumma*, which closely resembles the same form of growth as it is met with, for example, in the liver and testicles. Gummata of the heart appear as pale yellow patches in the cardiac wall, or as yellowish nodules which are found on section. They present a variety of appearances, according to their age. When young they are firm or even scirrhoid; elastic, and homogeneous; creak on section; and are very slightly succulent: but when older, they become soft and cheesy, like a mass of 'yellow tubercle.' In either form the masses are not isolated, but pass continuously into the myocardium, either directly, or through the medium of soft vascular connective tissue, so that they have generally been described in this country as 'infiltrations' or 'deposits.' The superjacent endocardium or pericardium is vascularised and dull in the early stage of the nodules; opaque and thickened in the more advanced. The masses or nodules occur in various numbers in different instances, but are generally multiple. They may be found in any part of the heart. Gummata most frequently become caseous in the centre, as described; and they may then soften more completely and discharge inwards, leading to acute cardiac aneurism and ulcer of the wall; but more frequently the cheesy products are in a great measure absorbed, leaving a puckered fibroid patch behind.

The second form of syphilitic disease of the heart is the *fibroid patch*. This is sometimes well-defined and localised, and in such instances it represents the stage of full development of an area of ordinary syphilitic interstitial inflammation. In other specimens, the fibroid patches appear as irregular masses of indurated fibroid tissue, occupying part of the wall of the heart, and sending septa into the depth of the myocardium, whilst the endocardium and pericardium that correspond to them are opaque, thickened, and puckered. The syphilitic nature of such patches may be determined by the presence of specific lesions in other viscera.

A form of the disease intermediate between the two forms just described is one in which the outer zone of the gumma has undergone development into fibroid tissue, and the caseous centre remains as a 'fibrinous' mass.

The microscopical characters of syphilitic growths do not require to be described here. In the heart, the primary seat of the disease is the intermuscular tissue; the muscular fibres lying imbedded in the gummatous products or in the fibroid growth being either healthy in appearance, or fattily degenerated and broken up.

Syphilitic endarteritis (*obliterans*) may also occur in the vessels of the myocardium, and give rise to infarction of the walls of the heart.

Amongst the occasional effects of syphilitic disease of the heart are chronic aneurism of the walls; distortion of the ostia and of the valves and their appendages; and, more frequently, adhesion of the pericardium. Some of the other viscera present, as a rule, evidence of syphilitic disease.

Symptoms.—The subjects of syphilis of the heart may, from a clinical point of view, be divided into three classes. The first class of patients suffer from some one or other of the ordinary symptoms of chronic cardiac disease, such as dyspnœa, cardiac distress, palpitation, pulmonary complications, and general dropsy; whilst the physical signs are those of cardiac enlargement, and perhaps of valvular incompetence. Præcordial uneasiness, syncopal attacks, and remarkable infrequency of the pulse, have been prominent features in several recorded cases.

The second class of subjects of this disease die suddenly, after few if any complaints referable to the heart.

The third class die of syphilitic marasmus, and may or may not present some evidence—by physical signs or otherwise—that the heart is not sound.

In many of the cases, other symptoms of visceral syphilis—for example, phenomena connected with the brain and nervous system—have been prominent.

Diagnosis.—Well-defined symptoms or physical signs, such as those just mentioned, connected with the heart, occurring in a syphilitic subject, would, in the absence of other more probable causes, such as a history of endocarditis or Bright's disease, furnish considerable grounds for the diagnosis of specific cardiac disease.

Prognosis.—If such a diagnosis were positively made, the prognosis would be more favourable than it is perhaps in any other form of chronic heart-disease, inasmuch as the condition might be successfully removed by treatment.

Treatment.—Anti-syphilitic remedies, especially iodide of potassium, should be freely tried, along with the other remedies indicated on general principles. J. Mitchell Bruce.

HEART, Thrombosis of.—Synon.: Heart-clotting; Fr. *Thrombose cardiaque*; Ger. *Gerinnungen im Herzen*; *Herzpolypen*.

Definition.—Coagulation of the blood within the cavities of the heart during life.

Ætiology.—Thrombosis of the heart is most frequently due to local arrest of the movements of the blood, comparatively or absolutely, within its cavities. Such arrest is itself generally referable to weakness of the cardiac contractions, whether associated with dilatation secondary to valvular or pulmonary disease, or due to some primary affection of the muscular walls. The peculiar saccular condition of the extremities of

the auricular appendages, and the trabecular arrangement of the columnæ carneæ of the ventricles, as well as the distance of the same parts from the main blood-currents, determine the favourite localisation of the thrombosis. Roughening of the endocardium is another cause of thrombosis, but one which is to be considered less common than the causes already mentioned, unless the fibrinous coagula of endocarditis, or vegetations, be regarded as thrombi, which, in the strict sense of the term, they partly are. Possibly certain conditions of the blood may contribute to the occurrence of cardiac thrombosis. Finally, thrombi once formed tend to promote the further progress of the condition.

Anatomical Characters. — Coagula found within the heart are of two kinds, which have been termed *active* and *passive*, according as they are formed during life, or at or after death, respectively; and the characters of the former, with which alone we are here concerned, cannot be understood until those of the latter have been briefly described.

Passive coagula are found in the heart in most necropsies, occupying the track of the principal blood-currents. Frequently they appear as black or red blood-clots, occupying the auricles principally, and moulded in their cavities. In other cases they take the form of masses of firm whitish fibrine, cleaving with some tenacity to the endocardium, but not truly adherent; matted with the chordæ tendineæ and columnæ carneæ; and projecting some distance into the pulmonary artery. Or, thirdly, passive coagula may be a combination of the two previous forms, the upper part (according to the position of the body) being decolourised or fibrinous, and the deeper part resembling more an ordinary blood-clot. In certain cases these passive clots are peculiar. In phthisis and other diseases proving fatal by very slow exhaustion, they are remarkably firm and fibrinous, and closely matted amongst the chordæ tendineæ—appearances which seem to indicate that coagulation was slowly proceeding for some time before the heart had finally ceased to beat. In anæmia they are jelly-like and translucent. In leukæmia they are soft and creamy in appearance, and yield, when broken up, a puriform fluid. In the acute exanthemata these passive clots are soft and friable; and in many cases of these and of other forms of acute disease and of sudden death, no coagula are found in the heart, which contains only fluid blood.

Active coagula—the result of thrombosis of the heart—are, on the contrary, situated in the saccular appendages of the auricles, at the apex of the ventricles, and in the recesses behind and between the columnæ carneæ—in other words, as far as possible from the track of active blood-currents. In these situations they may be seen projecting in the form of fleshy knobs or globes, with their free surface smooth and rounded. Their deep surface is adherent to the endocardium, from which, however, it can generally be separated without much difficulty, leaving behind it a discoloured mark. If the thrombus be incised, it will be found to be laminated in structure, somewhat after the fashion of an onion, the colour of the section being greyish-brown or yellowish, with irregular patches of red and black. In most instances the centre is less firm than the periphery; and usually it is of a fluid consistence, in the form of a foul, sanious, puriform substance.

If the process of thrombosis have been proceeding for some time, these formations may extend in all directions, embrace the columnæ carneæ, coalesce in front of them, and finally may fill up a considerable portion of one, or even of more than one, cavity. The thrombi are generally friable; but sometimes they gain in firmness by the deposit of lime-salts within them; and at other times it is possible that they become detached and form into the 'fibrinous balls' which have occasionally been found lying free in the cavities of the auricles. Cardiac thrombi may, in part at least, be reabsorbed. They frequently give way during life; and portions of them, as well as of their puriform contents, are conveyed into the circulation, causing embolism and pyæmia.

It may be added that *embolism* of the heart has frequently been found—thrombi or simple clots, sometimes of remarkable size, having been carried from the veins, and arrested in the heart or in the mouth of the pulmonary artery.

Symptoms.—The clinical phenomena associated with true cardiac thrombosis may be best described as those of the last stage of chronic disease of the heart. Præcordial distress and restlessness; irregularity and feebleness of the pulse; œdema and coldness of the extremities; pulmonary congestion, infarction, and œdema; dulness of expression, and sopor, broken by low weak delirium; with other symptoms, as well as with the signs of cardiac failure and imperfect emptying of the cavities in systole—all these phenomena are associated with the process of active coagulation within the heart. It would not, however, be correct to describe these phenomena as symptoms directly referable to the thrombosis. All that can be said is, that in such a case thrombosis is probably going on and increasing the embarrassment and the gravity of the condition. An unusual degree of cyanosis appears in some instances. The symptoms of arterial embolism may suddenly make their appearance from detachment of particles of the clots; and, if the puriform contents find their way into the circulation, septicæmia may result.

The dislodgment *en masse* of a large venous thrombosis, and the impaction of the same, or of a 'fibrinous ball,' in one of the ostia of the heart have caused sudden death in several cases.

Passive coagulation.—It should be added that the appearance of the 'passive' form of coagulation within the heart, which has been already referred to as a post-mortem process, or one occurring *in articulo mortis*, has been otherwise interpreted by some authorities, who regard passive coagula as formed *ante mortem*, and as giving rise to severe symptoms by the embarrassment which they produce in the circulation. The symptoms caused by this condition are said to be—great præcordial pain and distress; tumultuous action of the heart, passing on to irregularity, flickering, and finally arrest, whilst the pulse is very feeble; urgent dyspnœa; cyanosis;

hæmoptysis; coldness of the extremities; deepening stupor; and coma ending in death—in short, the congeries of symptoms which would be referred by most authorities to failure of the muscular walls of the heart, the coagulation being regarded by the latter as only another result of the same condition.

Diagnosis.—In the presence of the very serious and complex conditions with which cardiac thrombosis is usually associated, the question of its existence can hardly be said to occur to the physician as a point of great importance. An unusual degree of cyanosis, especially if it be progressive, favours the recognition of this state; and in the absence of valvular disease, the occurrence of embolism or pyæmia would tend to confirm it.

Treatment.—The treatment of cardiac thrombosis consists in the treatment of its cause; and nothing is demanded or can be done for the former which is not indicated for the relief of the latter.

Those authorities who see in 'passive' coagula the evidence of rapid *ante-mortem* thrombosis, recommend the use of stimulants, and even of certain drugs which are supposed to have a solvent effect on fibrinous deposits, especially ammonia. J. Mitchell Bruce.

HEART, Tuberculosis of.—Independently of the pericardium, the heart itself is believed to be rarely the seat of tubercular disease. Grey miliary tubercles have been found in the connective tissue of the wall of the heart, in some cases of acute general tuberculosis. In other instances the 'tubercle' has been of the yellow or cheesy kind, in the form of small nodules lying at various depths in the muscular tissue beneath the pericardium; the latter also being frequently affected, as well as the lungs, intestines, and other organs.

There appears to be no evidence that tuberculosis of the myocardium gives rise to definite symptoms, or that it can be recognised during life. J. Mitchell Bruce.

HEART, Valves and Orifices of, Diseases of.—Classification.—The diseases of the valves and orifices of the heart which produce mechanical disorders of the circulation, by establishing abnormal relations between those parts, are of two kinds—*obstructive* and *regurgitant*. Valvular disease, on the one hand, is said to be *obstructive* when narrowing of an orifice presents an obstacle to the passage of the blood-current—a condition better named *stenosis*. On the other hand, when the blood regurgitates or flows back through an orifice, in consequence of imperfect closure of the valves, due either to valvular changes or to widening of the orifice, the condition is called *regurgitation* or *insufficiency*.

Aneurism of the valves of the heart will be discussed separately. *See* Heart, Valves of, Aneurism of.

Ætiology.—Each of the orifices may be affected with one or both forms of disease, but the frequency with which the several orifices are attacked varies. The results of organic disease are chiefly met with in the left side of the heart, and are due to local inflammation—endocarditis and its consequences; or to chronic degenerative changes, such as atheroma. In adult life the valves of the left side are more frequently affected than those of the right, because they have to bear a much greater pressure; but in fœtal life, when the condition is reversed, the right valves suffer more. Endocarditis is commonly of rheumatic origin, and attacks the mitral more frequently than the aortic valves; the former having to sustain the full force of the ventricular systole, while the latter only bear the force of the aortic recoil. In addition to rheumatic fever, the chief diseases which tend to develop endocarditis are—pyæmia, puerperal fever, the exanthemata, chronic renal disease, and syphilis. The aortic valves are more commonly affected than the mitral by chronic endarteritis extending from the aorta, the chief causes of which are gout, old age, syphilis, and the abuse of alcohol. These facts explain why mitral affections (commonly rheumatic) occur mostly in early life, and aortic affections in later life. Valvular lesions are more common in men than in women, from the strain of the heart incidental to more laborious occupations. Strain helps to swell the greater proportion of disease of the aortic valves, which are liable to rupture from effort; but similar accidents may occur to the mitral valve and its tendinous cords.

Anatomical Characters.—The pathological changes in the valves and orifices of the heart, which cause valvular defects, are mostly the results of acute or chronic endocarditis. In the acute form, the valvular defect is caused by the growth of vegetations which prevent the action of the valve-segments; or by softening and ulceration of the valve-structure, which lead to valvular aneurism and perforation, or to loss of substance and consequent insufficiency. The more chronic form of inflammation produces thickening of the valves from overgrowth of the connective tissue, with subsequent calcareous degeneration and retraction from shrinking of the hyperplastic connective tissue; or adhesion of the valve-segments causing stenosis.

Aortic stenosis is generally the result of thickening and calcareous degeneration of the valves, or of deformity of the valves from vegetative growths, which obstruct the free passage of the blood from the ventricle. Sometimes it is due to adhesion of the valves preventing their elevation, and causing them to form a diaphragm with a narrow central aperture. More rarely it is caused by contraction of the fibrous ring of the aortic orifice, or by endocardial thickening producing contraction immediately beneath the valves.

Mitral stenosis results most frequently from thickening and rigidity of the valves, which adhere at their edges to each other, so as to form a diaphragm between the auricle and the ventricle. This diaphragm is usually funnel-shaped, with a button-hole aperture sometimes not larger than a goose-quill. In these cases the tendinous cords of the valve are shortened, and their muscles thickened. In some cases the valves are smooth and thin; in others they are thickened, studded with vegetations, rough and calcareous. This latter state may cause stenosis.

without any funnel-formation, as may also fibrinous clots or polypi obstructing the orifice. In many cases of mitral stenosis, the valves are also insufficient.

Aortic insufficiency often depends on dilatation of the aortic orifice, due to softening of the aortic coats, with little or no change in the valves, which are incapable of closing the enlarged orifice. Vegetations, thickening, retraction, calcareous degeneration, adhesions, perforations, loss of substance, and rupture of the valve-segments by effort are all causes of aortic insufficiency. In rupture of the valves, a full description of which was first given by Dr. Quain (*Edin. Monthly Journ.* 1846), the valve-segment is torn from its angles of attachment, and its free edge retroverted towards the ventricle. This accident happens more frequently in cases where the valves were previously diseased, and in such cases further laceration may occur.

Mitral insufficiency is due to thickening, retraction, or deformity from vegetations of the valve-curtains; adhesion of the curtains to each other or to the ventricular wall; and calcareous degeneration. In some instances, one of the valves is perforated or torn; and sometimes the tendinous cords are shortened and thickened, or ruptured as the result of degeneration, preventing the normal action of the valve-curtains. In rarer cases associated with dilated ventricle, the papillary muscles are so weakened by degeneration that they can no longer aid in the closure of the orifice. Dilatation of the left auriculo-ventricular orifice is also a cause of mitral insufficiency.

Valvular defects on the right side of the heart are due to similar changes. They arise chiefly during fœtal life, when the right cavities have to bear greater pressure. In adult life these defects are generally associated with diseases of the lungs, which cause increased tension in the right cavities, leading to their dilatation.

Combined valvular lesions are not infrequent. The most common are stenosis and insufficiency of the aortic valves, and the same morbid changes of the mitral valves. In the last stages of both forms of aortic valve-disease, the mitral valve becomes insufficient, either from chronic endocarditis, or from dilatation of the ventricle and of the auriculo-ventricular orifice. Mitral stenosis is not very frequently associated with aortic insufficiency, but is more commonly connected with some degree of narrowing at the aortic orifice. Tricuspid insufficiency is usually met with in the last stages of diseases of the left heart.

Symptoms.—Valvular diseases of the heart produce a series of morbid phenomena, which are connected together by a necessary sequence. Each and every form of valvular defect impairs the perfection of the heart as a pumping machine, and disturbs the normal relations between the contents of the arteries and of the veins. Wherever the valve-mischief is, and whatever its nature, it robs the arterial circulation and enriches the venous. In front of the lesion there is less blood; behind it there is more. In aortic valvular diseases, the first effects are increase of the blood-pressure in the left ventricle, and lessened blood-pressure in the aorta; next, from the difficulty which the auricle has in emptying all its contents into an overful ventricle, there is produced increased pressure in the left auricle and pulmonary veins. Mitral valve-lesions cause similar results: first, increased pressure in the left auricle, less pressure in the left ventricle, and consequently lessened pressure in the aorta; with a gradual increase of pressure extending from the left auricle to the pulmonary veins. Aortic affections thus act first on the arterial, and secondly on the pulmonary circulation; while mitral lesions affect the pulmonary vessels more immediately. The final results of the two forms are, however, identical, and may be stated in the form of a law, namely, that all valvular diseases of the heart tend to lessen the quantity of blood in the arterial system, and to produce overfulness and stasis in the veins. From this there follow various associated visceral disorders. These disorders, however, vary greatly in the period of their occurrence, and in the intensity of their manifestations. This result is due to the more or less perfect way in which the original valvular defect has been compensated for, by changes in the power of the cardiac muscle and in the capacity of the cardiac cavities. These changes often suffice to maintain fairly the normal balance between the arterial and venous contents, thus *compensating* for the valve-lesion; and the process by which this is effected demands careful consideration.

Compensation.—Compensation is effected differently, according to the form of disease. It may be stated generally, that it consists in hypertrophy of the cavity immediately behind the defect. Now hypertrophy means increased contractile power, and this means better filling of the arteries, and consequently increased arterial tension. Thus it makes up for the valvular incompetency, which tends to lessen arterial tension. When the increased power of the ventricle exactly balances the effects of the valvular mischief, the compensation is complete.

In *aortic stenosis*, hypertrophy of the left ventricle is the mode in which compensation is effected; the obstacle to the blood-current is overcome by increased power.

In *aortic insufficiency* there is some dilatation of the ventricle as the primary result of the lesion. This is counterbalanced by greater hypertrophy, and as long as the dilatation does not progress, the insufficiency is compensated for. A sufficient excess of blood is thrown into the aorta at each systole to allow for the regurgitation during each diastole, and thus the balance is maintained, though not always equably.

In *mitral lesions* the left auricle is dilated as the primary consequence of the condition of the valves; hypertrophy follows, but is insufficient to prevent increased fulness of the pulmonary veins. This impedes the circulation in the lungs; and increased tension in the pulmonary artery soon begets the necessary hypertrophy of the right ventricle. It is by means of this increased power of the right ventricle, that the blood is driven through the lungs in spite of the defect in the left heart, and pulmonary stasis is prevented; and the blood entering the left auricle under greater *vis a tergo*, the compensation of the valvular defect is effected. The compensation, from the nature of the means on

which it depends, is manifestly less perfect than in aortic lesions.

On the *right side of the heart* similar modes of compensation are observed.

The basis of the salutary changes just described is increased cardiac nutrition; and consequently a free coronary circulation is a necessity. Conditions which interfere with this prevent compensation, and so diminish the duration of life. Wherever the compensation begins to fail, dilatation of the cavities and vessels behind the lesion commences. This may, however, be checked, and the power of the heart restored for a time. Sooner or later, however, changes in the nutrition of the cardiac muscle, in the vessels, and in the general nutrition, bring on failure of compensation. The cardinal symptom in such cases is weakened contractile power of the heart, or *asystoly* (Beau). In this state, the cavity chiefly affected has no longer power to expel its contents fully into the vessels, and consequently becomes gradually and increasingly distended. Failing compensation in aortic valve-disease manifests itself by dilatation of the left ventricle, and the development of secondary mitral insufficiency. Similar retro-dilatation marks the failure in mitral cases, only here it is the right ventricle which dilates, and tricuspid insufficiency and general venous stasis are added to the pre-existing pulmonary engorgement.

The earliest *symptoms of failing compensation* are attacks of palpitation from very slight exertion or excitement, or during sleep. Irregularity of the pulse soon follows, if it have not previously existed. This is especially the case in mitral disease. The irregularity is due not so much to true cardiac intermission as to abortive contractions, which do not reach the wrist; or to contractions unequal in force or in the quantity of blood expelled. The pulse is small, unequal, irregular, and compressible. In aortic valvular disease true intermissions occur, and are of grave import. With failing cardiac power there usually supervene cardiac oppression, anginous attacks from distension of the cavities of the heart, and faintness and giddiness from cerebral anæmia.

Visceral complications.—The most important of the associated disorders of chronic valvular disease, depending on defective contraction of the heart, are the visceral congestions.

In the *lungs*, the habitual engorgement of mitral diseases produces a hyper-secretion of mucus and a state of chronic catarrh. The blood-vessels also undergo changes from the excessive intra-vascular pressure, and become dilated, varicose, and atheromatous: whence œdema and hæmorrhage arise. In mitral stenosis especially, grave and frequent attacks of hæmorrhage, with laceration of the pulmonary substance, are liable to occur. The lungs, from repeated attacks of this kind, undergo brown induration. The varicose condition of the vessels in the alveoli interferes with oxidation, and so aids in the deterioration of blood, which the other visceral congestions favour.

In the *liver*, the general venous stasis is felt by the obstruction to the passage of blood from the hepatic veins into the inferior cava. Passive congestion ensues, and 'nutmeg liver' results. This term 'nutmeg liver' refers to the rough changes in the viscus, the dark congested centre of each lobule being surrounded by a paler area. In course of time the compression of the central cells of each lobule by the distended veins leads to atrophy; the liver, from being large, shrinks in very chronic cases to half its size; and the condition may, like true cirrhosis, lead to ascites. The passive congestion in the liver, as in the lung, causes catarrh of the tubes, and may thus be productive of jaundice. Amongst other symptoms associated with the hepatic congestion may be mentioned hæmorrhoids and epistaxis.

The *spleen* is a very easily distended organ, and suffers like the liver, but frequently before it; and this may partly account for the pain which is often complained of beneath the left ribs. In long-standing cases the spleen becomes tougher, and the capsule opaque and thickened; while hæmorrhagic infarcts are common.

From the hepatic congestion there naturally follows distension of all the other radicles of the portal vein: hence the congestion and chronic catarrh of the *stomach* and *intestines*, which impede digestion and assimilation, and so reinforce the other causes producing the cachexia of chronic valvular disease.

In all cases of valvular disease, when the mechanical effects extend to the general circulation, the function of the *kidneys* is more or less disordered. The first stage of general circulatory trouble is lessened arterial tension; this makes itself felt in the Malpighian tufts, and is manifested by scanty, dense, high-coloured urine. When the more advanced circulatory trouble—namely, general venous stasis—is developed, a further change takes place in the urine. The arterial anæmia keeps it still scanty and dense, but the venous stasis in the kidney leads to the transudation of serum—a dropsy of the kidney as it were; and consequently albumen appears in the urine. Long-continued venous congestion ends in structural changes, which, as elsewhere, consist in connective-tissue hyperplasia and degenerative (rarely fatty) changes in the tubules. These renal changes sometimes add uræmia to the patient's ailments.

In the *brain*, decided alterations are not found, except when a detached vegetation produces embolism and its special phenomena. The brain-substance is, however, generally œdematous, and the membranes are thickened. Delirium is an occasional symptom in heart-disease, and when present to any degree is of evil import. The blood-vessels of the general circulation are frequently affected with atheroma in hypertrophy of the left ventricle, and it is these degenerative changes which favour the occurrence of apoplexy.

General dropsy.—The mechanical impediments to the circulation which produce these several visceral congestions, also manifest themselves in the general dropsy which is common in the last stages of heart-disease. The dropsy begins as a puffiness of the ankles at bed-time. The general venous stasis, thus first indicated, advances slowly and surely, if not checked, to general anasarca, and even to dropsy of the serous cavities. The increased venous tension, and the hydræmia of blood-deterioration, are

the causes of this serous transudation, which shows itself first in the feet, the most dependent portions of the body, where the pressure of the blood-column is naturally greatest. The horizontal posture, by distributing the pressure, is sufficient at first to disperse the œdema of the ankles. General anasarca is much more frequent in mitral than in aortic lesions.

In some cases a solid form of œdema is observed. This occurs mostly in the last stages of valvular affections, and is due to thrombosis of venous trunks, in which, the circulation being much impeded, coagulation easily takes place. The termination of the external jugulars is a common site for such thrombosis; and the left innominate vein, from its transverse position, and from its emptying almost at right angles to the current in the superior vena cava, is, in the writer's experience, more commonly obstructed than the right. Solid œdema is consequently seen more frequently on the left side of the head and neck and in the left arm, than on the right side.

Defective compensation.—The phenomena just described are associated with valvular diseases of the heart, as the consequences of partial or defective compensation. These conditions are more or less developed according to the individual case, and consequently give rise to symptoms in varying degrees. These symptoms will now be described.

Palpitation is intimately related to the state of cardiac nutrition and innervation, and has no special connection with any form of valvular disease. Cardiac pain, varying in intensity from mere uneasiness to the agony of angina, is most common in aortic cases, and is associated with endarteritis, or with dilatation of the left ventricle, or is a neuralgia of the cardiac plexus. In mitral affections, pain arises from over-distension of the left auricle, and its pressure on neighbouring parts, and later on from dilatation of the right ventricle. Dyspnœa may be present in any form of valvular disease, but it is often absent from the earlier history of aortic cases, while some dyspnœa is always present in mitral cases. This difference is due to the absence of pulmonary congestion in aortic affections, whilst it is more or less present from the first in mitral affections. The dyspnœa is a breathlessness rather than a difficulty of breathing. It is panting and gasping in its character, with acceleration of the rate. It is aggravated by any movement, and often compels the patient to sit upright (orthopnœa). Headache, vertigo, dreaming, night-frights, and sleeplessness are other symptoms, which depend on disordered cerebral circulation. Sleeplessness is one of the most distressing of all symptoms, and can only be relieved when the dyspnœa is lessened. Other more special symptoms will be found in certain cases, and will be traceable to the disturbances in the circulation, which the particular form of valvular disease has engendered.

Physical signs.—The physical signs associated with valvular affections may be said to be—first, those of alteration in the size of the heart; and secondly, those of mechanical disorders of the circulation; together with one or more endocardial murmurs. The persistence of a murmur is the cardinal sign, and if the murmur be either diastolic or præsystolic in its rhythm it is of absolute value. A systolic murmur may be caused by poverty of blood—anæmia, especially at the base of the heart. But in such a case—that is, in hæmic murmur—there is no cardiac hypertrophy, as indicated by increased cardiac dulness, though there is often nervous overaction of the heart. There is no accentuation of the pulmonary second sound, inasmuch as there is no extra fulness of the pulmonary blood-vessels from obstructed circulation. The pulse in anæmia is generally quick, ample, and compressible, but, withal, jerky; while with an organic systolic murmur it is generally slow, rising gradually under the finger, and not very compressible, (aortic stenosis), or small, irregular, and unequal (mitral insufficiency). The clinical methods of investigating valvular lesions are mainly inspection, palpation, percussion, and auscultation. The signs of each form of valve disease are stated below; and on these the special diagnosis rests.

Diagnosis.—In *Aortic stenosis* there is often some prominence of the præcordial region, and a steady forcible impulse is perceived below and to the left of its normal position. A thrill, systolic in time, may often be felt at the base of the heart. On auscultation, a loud, frequently rough, rasping, sometimes musical, murmur is heard with the first sound at mid-sternum, and also at the second right intercostal space. The murmur, commencing with the first sound, extends to the succeeding second sound, which is often not very distinct. The murmur is audible all over the upper part of the thorax, especially on the right side; is conducted along the great vessels to the left vertebral groove, and it may be even to the lower dorsal vertebræ; and is occasionally heard at the apex of the heart. The pulse is regular, slow, retarded by the narrowing of the aortic orifice, and slowly developed under the finger. The sphygmogram (*see* fig. 82) shows the line of ascent to be oblique or broken, instead of nearly vertical; the summit is generally blunt; and the line of descent shows small or no secondary waves, and ill-developed dicrotism. Aortic stenosis when moderate, requiring only hypertrophy of the left ventricle for its compensation, is often very perfectly remedied by this change, and produces little or no disorder of the circulation. When the stenosis is great, epileptiform and syncopal attacks may occur, and lead to sudden death. When the compensation fails, the mitral valve often yields, from the dilatation of the left ventricle, and degeneration of the papillary muscles. Then the pulmonary second sound becomes accentuated; the pulmonic circulation is embarrassed; and dyspnœa, bronchial catarrh, pulmonary hæmorrhage, œdema, and cyanosis supervene.

In *Aortic insufficiency*, inspection discovers a more forcible and diffused impulse, lower than natural, sometimes as low as the seventh intercostal space, and outside the nipple line. The præcordial region may be bulging from the violent action of the heart; pulsation may be seen in the upper intercostal spaces at the right edge of the sternum; and a thrill may sometimes be felt there. The great vessels of the neck

pulsate visibly. The area of cardiac dulness is increased in all directions, but mainly vertically. On auscultation, a murmur is heard, replacing and following the second sound, of a blowing or hissing character, rarely rough. It is usually loudest at mid-sternum and in the second right intercostal space; and it is conducted upwards to the right clavicle, but mainly downwards to the xiphoid cartilage. It is not heard at the back of the chest. It may be conducted to the apex of the heart rather than to the ensiform cartilage; and this occurs, in the writer's opinion, when the posterior or mitral segment of the aortic valves is the incompetent one, as the regurgitant current then falls on the mitral valve, and the murmur is thus conducted to the apex. The second sound may be wholly lost at the base of the heart, being replaced by the murmur; but in some cases it is audible—this being due either to normal closure of one or two aortic segments, or to the propagated pulmonic second sound. If audible in the carotids, the second sound is aortic, and is of some value as indicating partial competency of the valves. The second sound is often audible at the apex. The first sound at the base is almost always modified, being generally murmurish and often obscured by a systolic murmur, due to slight obstruction from thickening of the valve-segments, and the vigour of the ventricular systole. In some cases there is no distinct first sound audible at base or apex; its absence being possibly due to noiseless closure of the mitral valve by the intra-ventricular blood-pressure before the systole occurs. In the majority of cases the insufficiency is no doubt associated with some stenosis, and the murmur is double; a short rough systolic portion, with a softer, longer, and more hissing diastolic portion. This double murmur might be well called the *up* and *down* murmur of aortic valve-disease: the two descriptive words indicating the length, and, to some extent, the characters of its component parts.

The signs connected with the pulse in aortic insufficiency are very significant. As the pulsations of the aorta are visible to the right of the sternum, so the arteries often beat visibly all over the body, even to the radial, temporal, and dorsal arteries of the foot. The ophthalmoscope has shown the same phenomenon in the central artery of the retina. This remarkable movement of the arteries is due to two causes:—first, to the hypertrophy and dilatation of the left ventricle, which throws an excessive quantity of blood into the vessels at each systole; and, secondly, to the sudden collapse of the arteries, due to the aortic insufficiency. The arterial recoil during the ventricular diastole is not opposed, as in health, by the resistance of the perfectly closed aortic valves, and, consequently, the blood-column is not sustained, and the arteries collapse. These locomotive features in the pulse are generally increased by elevating the arm. The pulse is sudden, short, large, regular, rapidly collapsing, and vibratory. The sphygmographic tracing brings out these characters: the line of ascent is vertical and lofty; the summit is sharp and pointed; the line of descent falls rapidly, and is broken by a series of secondary waves due to vibratory conditions, but has an ill-developed dicrotism. The post-dicrotic portion of the tracing falls rapidly, from the absence of a sustained blood-column. The longer and more oblique this portion of the tracing, *cæteris paribus*, the less copious the regurgitation (*see* fig. 81).

Aortic insufficiency often lasts for many years without producing any obvious disturbance of the systemic and pulmonic circulations; hence the absence of dyspnœa and œdema. The hypertrophy and dilatation of the left ventricle, which form the compensation, suffice to prevent ill effects. At each systole the dilated ventricle throws sufficient blood into the aorta to allow for the reflux, and to maintain a fair arterial tension. Thus the compensation is perfect. In many cases, however, if the reflux is free, and the coronary segments of the aortic valves are affected, the coronary arteries, which are mainly filled by the arterial recoil, are deprived of the full force of the blood-wave, and the nutrition of the heart consequently suffers. This is the great source of failing compensation, and the mal-nutrition of the cardiac muscle soon leads to dilatation of the ventricle, secondary mitral insufficiency, and atrophy.

When the hypertrophy is excessive, as it is in some cases, there are flushings of the head and face, headache, vertigo, and violent arterial action all over the body.

In *Mitral stenosis* there is rarely any prominence of the præcordial region; and in its earlier stages neither increase of the cardiac dulness, nor alteration in the position of the impulse. The impulse, when regular, is fairly distinct, but it is often very irregular and is associated with a thrill, which precedes, runs up to, and terminates in the impulse. In advanced cases, the area of cardiac dulness is increased laterally; the impulse is diffused, and may be seen in the epigastrium; and the left auricular systole may be noticed, if the chest be thin, in the third left intercostal space. The sounds heard on auscultation in this lesion vary. The pathognomonic sign is a murmur preceding the systole, and ending with its commencement. This is best called the *præsystolic* murmur (also 'auricular systolic'); and is produced when the contracting auricle forces blood under high pressure into the ventricle. It is the passage of a stream of blood in a state of high tension into blood already in the ventricle which causes the murmur. The first portion of the blood passes from the auricle into the ventricle noiselessly; and it is only when a stream of higher tension is forced into it by the true auricular systole that the murmur is developed. The murmur is, therefore, short in most instances, occupying the last part of diastole; runs up to the first sound; and ends abruptly in it. The position in which the murmur is best heard in its typical præsystolic form is at the left apex itself or a little above—that is, lower than a mitral regurgitant murmur. The funnel-like shape of the mitral valve-curtains in these cases accounts for this, as the button-hole aperture through which the blood passes is closer to the apex.

The murmur in this form is not heard far from its seat of production, is soft and puffing, but may be harsh. It fills commonly only the last part of the diastolic period. In some cases the murmur is

longer, rougher, more rolling or grinding, and ends abruptly with the first sound, which is very flapping in tone, and might easily be mistaken for the second sound conducted. The careful observation of the impulse or of the carotid pulse with the finger while auscultating, is necessary in order to avoid the error.

A special peculiarity of the præsystolic murmur is its variability: it is the only organic murmur which disappears and reappears as the heart-conditions change. For instance, a murmur, inaudible while the patient is at rest, is developed by a little exercise; or again, an irregular tumultuous action of the heart masks all murmur, which becomes distinct as the heart steadies down under the action of digitalis. In other cases there is no distinct murmur, but only a slightly prolonged and rough or grinding first sound. In cases of mitral stenosis there is accentuation of the pulmonary second sound, from the greatly increased tension in the lesser circulation; there may also be a doubling or reduplication of the second sound at the base. This reduplication is a sign of great value in cases in which the prolonged or grinding first sound is the only sign. The reduplication of the second sound is due to a want of synchronous closure of the pulmonic and aortic valves, from their altered relative tension. A doubling of the first sound is sometimes noticed, probably due to retarded closure of the mitral valve, from lessened fulness of the left ventricle.

The rhythm of the heart is frequently greatly disordered in mitral stenosis, and also in mitral insufficiency. A few beats occur regularly, or nearly so, and then a series of very small hurried ones follows, to be again succeeded by stronger and better pulsations. These irregularities are referable to the varying charges of blood on which the ventricle contracts. The over-distended right cavities and the left auricle contract rapidly to expel their contents, but the narrowed mitral orifice does not allow a full charge to pass into the ventricle; the diastole is too short for this purpose; and the wave of contraction passes on to the ventricle from the auricle, producing a series of small ineffective pulse-beats, each representing the small charge sent into the aorta. When the series of ineffective contractions ceases, the next diastole is longer; and the succeeding systole sends, as the sphygmograph shows, a fuller charge into the arteries. During the small irregular beats the præsystolic murmur is often indistinguishable, but is again heard with the succeeding slower and more effective beats. This irregularity in the heart's rhythm, however, is not present in all cases of mitral stenosis. In some instances the heart's action and the pulse are regular. The sphygmograph in such cases records a small pulse of low tension, with a little inequality in the volume of the beats; this inequality is often increased by exercise. In other cases the pulse-tracing is small, irregular, and unequal in its pulsations, and marked by true and false intermissions (*see* fig. 84).

In the earlier stages of mitral stenosis the face may be pale, and the congestive symptoms which mark mitral insufficiency are absent till the later stages. This form of valvular lesion gives rise more commonly than mitral insufficiency to hæmorrhagic infarction in the lungs; but in other respects the pulmonary and systemic circulations suffer in the same way as described in the other form of mitral disease.

In *Mitral insufficiency* inspection discovers some slight prominence of the præcordial region, with increased impulse, the apex often beating to the left of the nipple line. The area of cardiac dulness is augmented mainly in a lateral direction, from the hypertrophy of the right ventricle. On auscultation, a murmur is heard with the first sound, and following it; loudest at the apex; loud along the left edge of the heart; but absent or not so distinct over the right heart and at the base. The murmur is propagated towards the left axilla, and is audible in most cases in the left vertebral groove. The murmur is usually loud, blowing, and distinct in its character, keeping the same tone throughout. The true first sound is generally obscured by it, but in some cases may be heard through it, and is then due to the partial closure of the mitral, or to the action of the right auriculo-ventricular valves. The pulmonic second sound is commonly accentuated. The pulmonic first sound has in some cases a murmurish character, due probably to the vigour of the right ventricular systole.

The radial pulse in cases of fairly perfect compensation is regular, but quick, small, weak, and easily compressible; and the sphygmograph shows low tension, and an inequality in the size of the pulsations. In cases of less perfect compensation, it becomes irregular and intermittent. In all cases the pulse-beat is weak in comparison with the vigour of the ventricular systole (*see* fig. 83).

There is no unusual fulness of the superficial veins in the earlier stages of mitral insufficiency. Later, when the right cavities become over-distended, the veins of the neck become full and may even pulsate. This is very distinct when the tricuspid valve gives way. In all cases slight exertion is sufficient to induce dyspnœa; and there is an ever-present tendency to bronchial catarrh, from the congested state of the lungs. When asystoly comes on, the murmur becomes less distinct; the heart's action is rapid, irregular, and tumultuous; the accentuation of the pulmonary second sound is lost; dyspnœa becomes orthopnœa; and cyanosis, œdema, and hæmorrhagic infarction of the lungs, with general and visceral dropsy close the case.

Many cases of mitral regurgitation obtain fairly perfect compensation; but the disease, like mitral stenosis, of necessity entails some dyspnœa on exertion, and keeps up constantly an engorged state of the pulmonary vessels.

Valvular affections of the right heart, arising from disease, are rare. Those of the *pulmonic valves* are very rare; cases are on record, however, of pulmonary stenosis, and a few of pulmonary insufficiency. In the first case the systolic murmur is loud and superficial, and is heard loudest at the third left costal cartilage close to the sternum, and in the second left intercostal space; it is not usually conducted across the sternum, nor upwards to the right clavicle, as is an aortic murmur. A diastolic pulmonic murmur is soft and blowing; and is heard loudest

in the same situations, and downwards towards the ensiform cartilage.

The *tricuspid valves* are more frequently affected. Tricuspid insufficiency is indeed a common sequence of disease of the left side of the heart. Structural changes in these valves are, however, rare. Tricuspid insufficiency does not always produce a murmur; when present this is soft and short, and is heard nearer the middle line than a mitral murmur, at the base of the ensiform cartilage. The pulsations of the cervical veins may indicate the lesion when the murmur is absent.

Tricuspid stenosis causes a præsystolic murmur, harsh in character, loudest at the base of the ensiform cartilage and towards the left edge of the sternum, not propagated towards the left heart, and not audible at the back of the chest, though faintly conducted along the sternum to the base of the heart. A præsystolic thrill may be present. Mitral stenosis has been observed in association with this lesion, and two præsystolic murmurs may be made out in such cases.

The physical signs and the diagnosis of *combined valve-lesions* remain to be described. The mitral and aortic valves may each be affected with stenosis and insufficiency, from a single attack of endocarditis, or from one lesion arising as a consequence of the other. The double aortic murmur, above described, indicates the aortic combination; but it must be always remarked that the systolic murmur in these cases may exist with little or no actual stenosis.

In the double form of mitral disease, either defect may exist alone at first, and afterwards be associated with the signs of the second. In some cases the præsystolic murmur may fail to be heard, and a systolic murmur may alone be audible; in other cases, there is a prolonged apex-murmur which slightly changes tone; in other cases, again, a short grinding præsystolic murmur is followed occasionally, at an interval, by a soft, blowing, systolic one. The combination of aortic with mitral disease may be recognised by the presence of their special murmurs.

Prognosis.—It is very difficult to state general rules of prognosis in valvular affections of the heart, as so much depends on the peculiarities of each case. There are, nevertheless, certain broad rules. As regards origin, rheumatic inflammation is less serious than degenerative change, which occurs later in life, and is necessarily progressive. Accidental rupture is the gravest form of origin. The valve affected is also a prognostic element; but any attempt to arrange cases in order according to the seat of the valvular defect, must be open to so many exceptions that it must not be too much trusted. Speaking generally, however, tricuspid lesions are gravest, mitral less so, and aortic—especially aortic stenosis—probably least so. When the heart fails, and asystoly supervenes, the prognosis is worse, however, in aortic cases than in mitral.

Aortic cases are often free for years from any grave symptoms. When the murmur is conducted to the left apex, the prognosis is more favourable, as, the aortic segment affected being non-coronary, the muscle of the heart is not robbed of its blood. The presence of the second sound over the carotids is favourable. The pulse-tracing also affords valuable aid in prognosis, as it gives, by the size of the dicrotic wave and the obliquity of the line of descent, a rough measure of the amount of insufficiency. There is much more risk of sudden death in aortic cases than in mitral.

In mitral lesions the dangers arise from the pulmonary complications; embolism is more common than in aortic affections. Mitral cases can be rescued from asystoly more commonly, and die of advanced cardiac cachexia, generally with dropsy. Under favourable conditions of life, requiring little physical exercise and causing no emotional excitement, both forms of mitral disease are compatible with many years of life. When they are conjoined, the prognosis is more unfavourable. In cases of sudden insufficiency, produced by rupture of the valve-curtains or of the tendinous cords, death may occur very rapidly from the disturbance of the circulation.

The whole question of prognosis turns principally on the state of the myocardium. So long as this is sound, compensation may be maintained; the moment degeneration sets in, asystoly and all its evil train of symptoms come on. Thus asystoly coming on gradually, without any previous overstrain of the heart, is always most grave. Each successive attack becomes graver, and the visceral congestions which accompany it more stubborn. Albuminuria is a good index of the gravity of the congestion, and is serious in proportion to the frequency with which it has occurred. In some cases a copious flow of limpid urine is a very grave symptom. Dropsy of the extremities, and of the cavities more especially, is bad, as indicating failure in the peripheral circulation. Next to the cardiac muscle, the state of the peripheral vessels is most important; thus, atheroma and other conditions, such as febrile attacks, add to the danger by interfering with the circulation. The general nutrition of the patient suffering from valvular disease also enters into the prognostic problem. There is a cachexia proper to the end of heart-cases, which is due to the gradual deterioration of the nutritive fluids by the long-continued visceral congestions which hinder assimilation and excretion. Blood is less perfectly made and less perfectly purified; hence the steady deterioration of cardiac cachexia, which is always of evil import as regards duration of life. Valvular diseases are, however, in numerous instances compatible with many years of life. In some the healthy expectation of life may be attained; and, in many, years of comparatively active life are enjoyed. In the poor, the prognosis, as to duration, is not favourable; but in the well-to-do, all observers see many cases extending over a great number of years.

Treatment.—Valvular affections of the heart, whether the result of rheumatic inflammation or of degenerative change, are, as a rule, incurable. Some few cases of rheumatic origin lose the signs of valvular disease, and are practically restored by the after-processes (for example, contraction) in the inflamed valve; and some few cases also of mitral insufficiency, associated with dilated left ventricle, are cured by treatment. These exceptions are, however, few; and as we cannot repair the valve-mischief, in the vast majority of cases

our treatment must be directed to aid the compensatory hypertrophy, and to check the development of the consequences of the defect. The maintenance of the nutrition of the substance of the heart is, therefore, the main object of treatment; just as the state of the nutrition of the heart is the key to the prognosis. On this account the general regimen of heart-cases is very important.

General regimen.—The diet should in all cases of valvular disease of the heart be unstimulating but sustaining, consisting of a good proportion of albuminous food (underdone meat, eggs, and fish), with wine in moderate quantity, and some chalybeate water. There should be no unnecessary excitement of the heart, either by exercise or emotion. All athletics and violent efforts should be avoided by the young, especially in mitral cases. In aortic cases, steady exercise without strain is beneficial. The residence should be so situated as to avoid the necessity of exertion, sudden changes of temperature, cold, and damp. The chief object of the regimen should be to prevent anæmia; hence plenty of fresh air is essential. Tobacco is injurious. In early life over-exertion and exposure to cold—in adult life, emotional, sensual, and dietetic excesses, are the chief dangers. The propriety of marriage must be considered in each case on its merits. Women, as a rule, should not marry; when affected with mitral disease they are often barren. To men marriage is more generally permissible.

Medicinal treatment.—The therapeutics vary according to the stage of the cardiac disease. The mechanical defect of a valve first makes itself felt by palpitation and præcordial pain; these symptoms pass away when compensation is effected, but till then require treatment. In cases of mitral disease, tincture of digitalis (mx doses) relieves the palpitation; chloric ether is also a useful adjunct. In aortic cases, ether, diffusible stimulants, small doses of opium and belladonna, with the local application of belladonna to the præcordial region, are valuable remedies.

The præcordial pain, mostly retro-sternal, may, when severe, require a few leeches or cupping, but generally yields to mild counter-irritants, such as turpentine or mustard. Internally, the bromides are useful; when the pain occurs paroxysmally, ethereal preparations and ammonia act well.

When the compensatory changes in the heart are effected, the palpitation and pain decline, and the chief indication is to keep up the nutrition of the heart by the hygienic rules above given, and by the administration of preparations of steel, combined with arsenic, strychnia, quinine, and mineral acids. Chalybeate waters are also useful adjuncts. The syrup, infusion, and tincture of the prunus virginica are preparations of value in some cases after the use of digitalis. The secretions should be carefully watched, and the bowels opened freely every day, so as to avoid straining, and to relieve the portal circulation. The quantity of urine should be daily noticed, as it is a capital index of the state of arterial tension. Patients in whom the most perfect compensation exists, are, nevertheless, in a state of imminent trouble, for an exaggeration of a physiological act or emotion may disturb the unstable equilibrium of their health. In most cases the compensation breaks down sooner or later; and then begin the symptoms depending on pulmonary congestion and general visceral engorgement, with the consequent impoverishment of the blood. Dyspnœa marks the beginning of these troubles; anæmia and dropsy the close. The pulmonary congestion soon manifests itself by bronchial catarrh, which requires expectorants in various combinations, while friction, poultices, and counter-irritation are applied to the chest-walls. In capillary bronchitis with rapid pulmonary congestion, it is sometimes necessary to bleed from the arm to relieve the over-distended cavities of the right side of the heart. Nauseating doses of ipecacuanha, or actual emetics of sulphate of zinc, are sometimes very useful.

For the general visceral congestions our chief remedies are, firstly, diuretics; and, failing these, hydragogue cathartics. Of diuretics, the salts of potash, squills, broom, chimaphila, spirits of nitrous ether, juniper and digitalis are the most useful. The hydragogue cathartics, which relieve the over-distended portal vessels primarily, and the general circulation secondarily, are also most valuable; of these the compound powders of scammony and jalap in 20- to 40-grain doses; bitartrate of potash in electuary, ʒj to ʒij, every morning; sulphate of magnesia; pilula scammonii composita; elaterium; senna; and gamboge are the most trustworthy. By the judicious use of an occasional purgative, and the administration of a suitable diuretic, aided by cupping, poultices, and sometimes a small blister over the loins, combined with rest and stimulants, the worst cases of dropsy from cardiac failure are often saved.

For the dyspnœa and the insomnia, two of the worst symptoms, we have a remedy of great power in the subcutaneous injection of morphia in doses of one-sixth of a grain upwards. This remedy acts often like a charm, and may be used even in the worst cases of both mitral and aortic disease, but always with caution. Albumen in the urine does not necessarily contraindicate its use. In some cases chloral and bromide of potassium, alone or in combination, are valuable remedies for the insomnia, but they must be given cautiously. The bromides may also be prescribed with other sedatives for the dyspnœa. The compressed air bath in some cases also relieves the last symptom.

Dropsy, like the visceral congestions with which it is associated, requires the use of diuretics and hydragogue cathartics. When these fail, the swollen limbs may be sometimes punctured with benefit. Continued friction of the limbs, by stimulating the vessels, will often cause considerable anasarca to disappear. The drug on which main reliance must be placed when general dropsy supervenes is digitalis. This remedy has so great a share in the therapeutics of heart-disease, and a knowledge of its action is so important, that it must be discussed separately and last. Whatever views may be held as to the physiological action of digitalis, its greatest triumphs are seen clinically in the treatment of valvular diseases, when cyanosis, distended jugu-

lars, dyspnœa, congested viscera, dropsical limbs, scanty urine, tumultuous heart-action, and quick, irregular, and failing pulse, indicate asystoly. This assemblage of symptoms is mostly seen in mitral cases, and it is precisely in this class that the drug is most valuable. Under its use 'the pulse grows in force, fulness, and regularity; the arterial tension rises; the pulmonary congestion diminishes; the kidneys, before inactive, wake up to their work; and the advancing dropsy recognises its master and beats a sullen retreat.' In mitral stenosis these good results are due not only to the increased vigour given by the drug to the contractile power of the heart, but also to the fact that by its slowing action the diastolic period of each revolution is lengthened, and the time thus increased during which the over-full auricle can force its contents through the narrowed mitral orifice into the left ventricle. Digitalis here not only obtains a better filling of the ventricle, but a more effective discharge of its contents when filled; and thus, under its use, beat by beat, the general and pulmonary venous congestion is relieved. In mitral insufficiency it is almost equally potent. In both forms certain of its good effects would seem to be due to some influence, probably through the pneumogastric nerves, in producing contraction of the pulmonary blood-vessels. It is perhaps this property which makes it valuable in pulmonary hæmorrhages independent of heart-disease.

In aortic valvular diseases digitalis is not so valuable a remedy. In these cases the assemblage of symptoms mentioned above is not met with, except sometimes in the later stages, when the mitral valve is secondarily affected, and the case is not one of pure aortic disease. In these compound cases the drug is valuable, especially in combination with stimulants. In aortic insufficiency alone, the slowing action of the digitalis produces evil by increasing the length of the diastolic period of each revolution, during which the regurgitation takes place. The force it may give to the systole is no gain in the face of this slowing action, inasmuch as the aortic recoil gains in the same proportion as the ventricular systole, and thus forces blood back into the ventricle with increased vigour during the lengthened diastole. It is important in aortic insufficiency to encourage the frequency of the cardiac action; hence these cases are so constantly the better for bodily activity; and so, when the toning effects of digitalis are required, it should always be given in combination with ether and ammonia, to keep up quick action of the heart, and to prevent the vertigo and syncope which may otherwise occur. When there is excessive hypertrophy in cases of aortic insufficiency, digitalis is useful sometimes in quieting palpitation, reducing excessive frequency, and lessening headache and vascular excitement. Caffeine and veratrum viride also relieve these symptoms; but a few drops of nitrite of amyl inhaled from cotton-wool are more rapidly and surely beneficial than any other remedy. In aortic stenosis digitalis is rarely required. The simple mode of compensation makes these cases require little treatment. Digitalis is sometimes useful in combination with stimulants to give vigour to the myocardium, and check the tendency to dilatation. If it slows the action of the heart notably, its effect becomes hurtful. Nux vomica often prevents this.

In combined valvular lesions, the predominant lesion must be the guide in the use of digitalis; but it may be given advantageously whenever the general signs of venous stasis are present. The diuretic power of the drug is one of the best tests of its beneficial action. Relying on this test, the writer often gives digitalis for weeks, nay, months at a time, and obtains improvement in the nutrition of the heart which lasts long after its discontinuance. Digitalis effects this improvement by increasing the vigour of the coronary circulation, and thus builds up new heart-muscle to compensate a valvular defect.

The preparations of digitalis which may be used are, the powder in ½- to 1-grain; the tincture in ♏x. to xxx.; and the infusion in ℥j to ℥vj doses. As a diuretic in cases of dropsy, the old combination of squill, digitalis, and blue pill is invaluable.

BALTHAZAR FOSTER.

HEART, Valves of, Aneurism of.—DEFINITION.—A valvular aneurism is a circumscribed pouching or sacculation of one of the valve-segments.

DESCRIPTION.—Two forms of aneurism of the valves of the heart are met with. In the one, the whole thickness of the valve is dilated by the blood-pressure to form the pouch; in the other, one of the lamellæ being ulcerated by endocarditis, the blood pushes the remaining lamella before it to form a sac. The second form, which is sometimes called 'acute valvular aneurism,' occurs most commonly in ulcerative endocarditis. Valvular aneurisms vary in size, from a pea up to a pigeon's egg. The orifice is almost invariably towards the greatest blood-pressure—those on the mitral valve opening towards the left ventricle; those on the aortic valves towards the aorta. They are usually rounded in shape, but may have irregular prolongations between the lamellæ of the valves. Valvular aneurisms are sometimes multiple. The valves of the right side of the heart are seldom affected. The mitral valves are the seat of the larger aneurisms, and are twice as often aneurismal as the aortic valves.

Valvular aneurisms terminate commonly by early rupture, giving rise to perforation and consequent insufficiency of the valve, and often leading to considerable laceration. Rupture occurs more rapidly in aneurism of the aortic valves. Mitral aneurisms occasionally become chronic, and filled with coagulum; and aortic valve aneurism may also be found filled with solid clot.

SYMPTOMS.—The clinical history of this form of disease is defective. When seated on the mitral valve, aneurisms usually give rise to no signs until the perforation and laceration of the valve suddenly develop the murmur of mitral insufficiency. An aneurism of one of the aortic segments causes a soft systolic murmur over the valves, which one day, as the sac ruptures, is supplemented by the murmur, and accompanied by the symptoms of aortic insufficiency. The phenomena of this accident are similar to those of sudden rupture of an aortic valve.

BALTHAZAR FOSTER.

HEART, Wounds of.—Synon.: Fr. *Blessures du Cœur*; Ger. *Herzwunden*.

The subject of wounds and other injuries of the heart belongs more properly to the domain of Surgery, but being in several respects of much medical interest, it requires to be briefly discussed here.

Ætiology and Anatomical Characters.—Wounds of the heart may be punctured, incised, or lacerated; and inflicted with a variety of weapons or other sharp bodies, as well as by projectiles, especially bullets. Traumatic ruptures and contusions form another considerable class of injuries of the heart, which chiefly result from falls, crushing accidents (for example, being 'run over'), and blows. Injuries of the heart due to the entrance of foreign bodies, such as a needle or a bone, may be inflicted in some rare cases from the interior of the œsophagus or stomach; the most remarkable case of this kind being one of wound of the pericardium from behind by the point of a sword which a juggler had attempted to 'swallow.'

Post mortem, the chest-wall generally presents evidence of the wound that has been inflicted. The pericardium rarely escapes injury; its sac is found to contain blood in recent cases, or effused lymph or pus when life has been preserved for a few days or more. The walls of the heart at the seat of injury present different appearances, according to the precise nature of the lesion. Punctured and incised wounds may be of all sizes; take either a direct or an oblique direction through the muscular fibres; and are generally penetrating. Bullet-wounds cut away a portion of the heart, whether at the borders or from the thickness of the organ. Traumatic ruptures present special characters (*see* Heart, Rupture of). In all the varieties of injury of the heart, the wound is found plugged with blood-clot, the edges being either infiltrated or ecchymosed and torn. In cases that do not prove rapidly fatal, the usual signs of inflammation, or healing, and even cicatrization, are found in the heart; or aneurism of the cardiac walls may be developed as a result of the latter. The valves and their appendages are frequently incised or otherwise injured. In some cases a portion of the weapon, projectile, or foreign body may be found in the heart. The ventricles—and especially the right ventricle—are the parts of the heart most commonly injured. The great vessels, lungs, and the arteries of the chest-wall, may also be wounded in different instances.

From these appearances it is evident that wounds of the heart may prove rapidly fatal by loss of blood, by shock, or by compression of the heart resulting from hæmorrhage into the pericardium; whilst, at a later stage, pericarditis, myocarditis, and secondary hæmorrhage may be expected to supervene.

Symptoms, Course, and Terminations.—In about one-third of recorded cases of injury of the heart, either death is immediate—fainting, convulsions, and the other symptoms of syncope, as well as those of shock, being the prominent phenomena, along with external hæmorrhage; or the patient drops dead after a few moments, during which time he may have undergone considerable exertion. In a second class of cases, the symptoms of syncope or of shock occur immediately, but death does not at once ensue. The patient then lies in a state either of unconsciousness or of complete prostration. In the latter event he complains of a sense of great debility, præcordial oppression, dyspnœa, and suffocation; the surface is cold, pallid, and trembling; vomiting may occur; and there is usually hæmorrhage from the region of the heart. Death occurs after minutes or hours, either from exhaustion due chiefly to continued or repeated loss of blood, or from compression of the heart. In a third series of cases, the course is more protracted. The patient, after suffering from the symptoms just enumerated, but in a less degree, passes through the various phases of constitutional disturbance commonly observed in severe wounds, complicated, however, with pericarditis, myocarditis, and repeated hæmorrhage; and dies of exhaustion after an illness of weeks or months. Lastly, in a small proportion of cases, the patient survives the various accidents and complications just described, and the wound of the heart heals; but it sometimes happens that symptoms of aneurism of the cardiac walls, or of incompetence of the valvular apparatus, are developed as the result of the lesion.

Diagnosis.—Wounds of the heart can usually be diagnosed without difficulty by the situation of the external injury, and the severity of the symptoms. Similar symptoms may, however, follow injuries of the great vessels in the neighbourhood of the heart, or of the arteries of the walls of the chest, if the hæmorrhage be profuse; but unless there be almost complete certainty that a vessel within reach is the only seat of the bleeding, the diagnosis should be left undecided, and all dangerous interference avoided.

Prognosis.—Injury of the heart is generally to be regarded as certain to end in death; but it should not be forgotten that as many as 12 per cent. of recorded cases are said to have recovered. Some very remarkable instances have occurred of recovery after very severe injury to this organ; for example, a case in which a bullet was lodged in the substance of the heart for twenty years. (*See British Medical Journal*, March 23, 1867.) The prognosis may be broadly estimated by the severity of the immediate symptoms. Traumatic rupture of the heart is said to have invariably proved fatal.

Treatment.—In wounds of the heart, the hæmorrhage must be at once arrested by the usual surgical means; immediate death must be prevented by cautious stimulation; and the patient must be kept in such a condition that, whilst life is preserved, the danger of inflammatory reaction in the region of the heart, and of fresh hæmorrhage, is reduced to a minimum. It is on this account that restorative measures are to be guardedly employed at first, and resorted to in the further progress of the case only when urgently indicated. Absolute rest of body and mind is indispensable. Nervine and cardiac sedatives, such as bromide of potassium, morphia, chloral-hydrate, and belladonna, may be of great service when used with judgment.

J. Mitchell Bruce.

HEARTBURN. — Synon.: Cardialgia. —

Heartburn is a hot or scalding sensation, usually referred to the cardiac orifice of the stomach, but in some cases diffused over the whole abdomen. It is frequently accompanied by eructations of a very acid character; and the fluid rejected from the stomach produces a sensation of scalding in the throat and œsophagus.

Ætiology.—Heartburn exists in a very marked degree in dilatation of the stomach, being produced by the decomposition of indigestible food retained in this organ. It constantly accompanies chronic catarrhal gastritis, the retained mucus enclosing particles of food in a state of decomposition, which set up fermentation in the materials of each meal as soon as it is swallowed. Heartburn is common in the later period of pregnancy, probably because the stomach is so displaced that it is unable properly to expel its contents.

Treatment.—This sensation is best treated by antacids, such as chalk, magnesia, alkalies, and alkaline waters. In some cases powdered charcoal relieves it. The diet for persons that suffer severely from heartburn requires careful regulation. All articles of food containing much fat, sugar, or starch, should be avoided. The use of tobacco should be interdicted; the writer has frequently seen obstinate cases kept up by smoking and chewing. Alcoholic stimulants should be used very sparingly, the least likely to do harm being brandy mixed with Vichy or potass water. The writer has obtained good results by substituting gluten bread for the ordinary baker's bread, and where this could not be taken, has found advantage from the use of aërated or some other kind of unfermented bread. Some women who suffer severely from heartburn when pregnant find relief from eating lettuce.

S. Fenwick.

HEART-CLOTS. *See* Heart, Thrombosis of.

HEAT, Ætiology of. *See* Disease, Causes of; and the following article.

HEAT, Effects of Severe or Extreme.—(*A*) Constitutional Effects of Severe Heat applied generally.—The constitutional or general effects of exposure of the whole body to high temperatures vary with the source and degree of heat, the slowness or rapidity of transition from lower temperatures, and the length of exposure; as well as with the age, constitution, habit and health of the body; and they are liable to be more or less modified or obscured by various concomitant circumstances and conditions, such as the barometric pressure, the hygrometric state, and the purity or impurity of the atmosphere.

The range of temperature within the limits of which life can be maintained appears to be greater in the case of man than in that of most of the lower animals, in virtue of greater power of accommodation to external influences, without undue elevation or lowering of the temperature of the body. But in every case any such combination of external circumstances as causes the temperature of the body to rise 10° to 15° above the normal standard speedily proves fatal.

Artificial heat.—Numerous observations and experiments show that in *dry air* exposure to very high temperatures can be borne, during periods varying with circumstances, without danger or even serious inconvenience, the temperature of the body being kept down within safe limits by evaporation from the surface and from the lungs. Thus, in Dobson's experiments, a temperature of 210° was sustained during twenty minutes; Blagden exposed himself during eight minutes to a temperature of 260°; Chantrey's workmen were accustomed to enter a drying oven in which the thermometer stood at 350°; and Chabert, the 'Fire King,' is said to have frequently exposed himself to a temperature of from 400° to 600°. Glass-workers, metal-founders, gas-stokers, engineers in steamboats—especially in the tropics — bakers' oven-builders, and others constantly carry on their work in temperatures of from 120° to 160°, or even higher, to say nothing of the blasts of radiant heat to which some are from time to time exposed. In *moist air*, evaporation from the surface and its cooling influence being diminished or prevented, much lower temperatures speedily become insupportable. Berger was unable to remain in a vapour bath the temperature of which had risen from 106° to 120°, although he had easily borne a temperature of 230° in dry air for five minutes.

The effects upon the temperature of the body, pulse, respiration, &c., recorded by previous observers, are, in the main, supported by the recent careful experiments of Dr. Fleming in the Turkish bath.[1] He found that exposure during an hour to a temperature commencing at 170° and lowered to about 130°, caused the temperature of his body (taken by a specially devised thermometer in the mouth), to rise rapidly during the first ten minutes from a normal average of 97·65° to 99·2° (a rise of 1·6°); and then more slowly until the end of fifty minutes, when the highest point 101·3° (a rise of 3·7°) was reached. His pulse rose during the first ten minutes from 78 to 91 beats in the minute, and like the temperature attained its maximum—115, at the end of fifty minutes. His breathing first diminished in rapidity from 22·5 to 20·8, and then increased to 25·4 in actual rapidity, but maintained a diminished ratio to the pulse. The arterial tension seemed to be increased by the greater rapidity of the heart's action, combined with the gorged state of the capillary circulation. The quantity of material eliminated during the hour amounted to forty-four ounces. The proportion of chlorides in the urine passed after the bath (3·65 in the 1,000) was little more than half that in the sweat (6·05) collected during the bath, and much less than in the urine previously passed (5·68). The proportion of urea in the urine was slightly increased, and the sweat contained 1·55 in the 1,000.

The effects felt by those exposed to great heat vary with the temperature, the length of exposure, and the collateral circumstances. A sensation of warmth, at first agreeable, is succeeded by one of oppressive and then painful heat, until this is again relieved by the establishment of copious evaporation from the surface. Pleasant

[1] *Journal of Anatomy and Physiology*, July 1879.

stimulation, and some degree of excitement of the nervous and muscular systems, are quickly followed by languor, lassitude, listlessness, feelings of exhaustion, indisposition to mental effort or muscular exertion, dizziness, tendency to sleep, faintness and unconsciousness, sometimes accompanied or preceded by convulsions. If relief is not afforded death ensues. If timely relief is afforded, more or less speedy and complete recovery may be brought about.

Symptoms and conditions closely or exactly resembling those of sunstroke, may be produced by exposure to an artificially heated atmosphere, or to blasts of radiant heat from fires or furnaces. If the symptoms have been severe and persistent, or if the sufferer has been exposed to repeated attacks, permanent damage to the health, and especially to the nervous system, almost certainly results, in spite of apparent temporary recovery. In many cases general debility and deterioration, in some cardiac troubles, and in others insanity, have been recorded as the persistent after effects.

Bernard, Delaroche, and others have shown that animals exposed to temperatures of from 130° or lower, to 150° and upwards, quickly die. The *post mortem* examination of animals so killed showed that the heart had entirely ceased to beat at the moment of death, and that neither it nor the muscular coat of the intestines could by any means be stimulated to contract again. The muscular fibres of the heart examined microscopically appeared rigid and coagulated (Kühne and Ranvier). Further, the blood in both arteries and veins was dark coloured. *Rigor mortis* set in very early, and general decomposition very speedily commenced. It would thus appear that (apart from sudden shock to the system generally) *the cause of death* from exposure to high temperatures is to be found in the effect produced on the muscular system of organic life, and especially on the heart. The cardiac myosin coagulates at 115°; and at a temperature considerably short of this its condition must be seriously affected.

Anatomical Characters.—The *post mortem* appearances met with in the human subject in cases in which death has been attributed to the general effects of heat have not been uniform. The following case, however, recorded by C. Speck[1] is noteworthy. A girl, æt. fourteen, the subject of chronic disease of many of her joints, was, on the advice of a quack, wrapped in a sheepskin warm from the carcase, laid in bed, surrounded with hot loaves fresh from the oven, and covered by the clothes. In about an hour she complained of pains, especially in one arm. She soon fell asleep. It was noticed that her chest rose and fell strongly. She perspired freely, and the sweat was frequently wiped off. She became very pale, and about three hours after the commencement of the treatment she expired, without having recovered, or at any rate manifested, consciousness. On *post mortem* examination the next day (the weather being cool and dry) advanced decomposition was found; the blood being black and fluid, and the blood-vessels, cavities, and tissues generally full of gas. The heat of loaves fresh from the oven, such as were put round the child, was found to be 185°.

[1] *Vierteljahrschrift für gerichtliche Medicin*, 1874; p. 249.

Treatment.—The *immediate* treatment to be adopted in the case of those suffering from exposure of the whole body to heat consists essentially in removal into a cooler atmosphere, quiet rest in the recumbent position; fanning; cool or even cold affusions or sponging, especially over the head and spine—the effect, however, being carefully watched; and the administration of cool or lukewarm fluid in small quantity at a time, with some stimulant. Copious draughts of cold water in a highly heated state of body are liable to give rise to dangerous or even fatal results. Bleeding is not to be recommended.

The *after treatment* must be conducted on general principles, and determined by the condition of the patient, and the indications afforded in the particular case.

Climatic and Solar Heat.—The effects of climatic heat experienced on transition from temperate to tropical regions are as follows:—1st. The average temperature of the body rises ·5° to 1° according to Davy and Crombie, or to a somewhat greater extent according to others. The daily fluctuations of bodily temperature in health in India correspond to those in England. The normal temperature of native Indians is about half a degree higher than that of Europeans (Crombie). 2nd. The pulse is quickened according to most observers, but Rattray says this is incorrect. 3rd. The breathing becomes slower and less deep, falling from about sixteen to about twelve or thirteen per minute. Less carbonic acid and less water are thus exhaled. 4th. The skin acts much more freely, its excretion being increased by about 24 per cent. (Rattray). The continued hyperæmia and over action of the skin, however, are liable to be followed by congestion and obstruction of the sweat follicles, giving rise to 'prickly heat.' 5th. The urine is diminished in quantity, and in amount of urea and chlorides. The experiments of Becher (confirmed by those of Forbes Watson) showed a constant relation between the temperature, and the urea and chloride of sodium got rid of by the kidneys. As the temperature rose from 50° to 70° an increase was found; but with a further rise from 70° to 90° an almost equally constant diminution occurred. 6th. The appetite, especially for animal food, is diminished, and the digestive powers seem lowered. 7th. Lassitude, languor, want of vigour, indisposition to exertion, and a sense of exhaustion of mind and body are experienced in degrees varying with circumstances; the depressing effects being most felt when the heat is not only great but continuous day and night, and when the atmosphere is moist.

The effects of the radiant heat of the sun, as distinguished from those of atmospheric heat, are not well made out. It would appear probable, however, that a physiological effect adverse to perspiration is produced by the direct rays (Parkes), and that thus, as well as from rapid evaporation, the skin gets dry, and becomes liable to certain structural changes, such as the formation of pigment, &c.

Exposure to the direct rays of the sun, or to great or continued heat in the shade, especially

under unfavourable atmospheric and general conditions, may give rise to heat-fever (Causis), heat-apoplexy, or one or other of the forms of sunstroke. *See* SUNSTROKE.

(*B*) **Local Effects of Severe Heat: Burns and Scalds.**—The local effects of heat vary with the degree, the length of exposure, the medium of application, and the part acted upon. *Burns* result from 'dry,' *Scalds* from 'moist' heat.

SYMPTOMS.—A comparatively slight degree of heat causes vascular turgescence, redness, tingling, pain, and tenderness, which soon subside. Desquamation of the epidermis may follow, but no permanent trace of injury is left. A higher degree causes severe burning pain, and great redness of surface, followed by effusion of serum beneath the cuticle (vesication.) Complete restoration without scar is usually effected. Still higher degrees of heat or longer exposure cause intense pain, and immediate destruction, or consecutive destructive inflammation, of the true skin to a greater or less depth. Sloughing and suppuration follow, and permanent scarring results. Violent heat and prolonged exposure cause complete disintegration and charring of the structures especially acted upon, followed by destructive inflammation and sloughing of others to a still greater depth and extent. Loss of parts and more or less serious deformity and scarring necessarily result. The separation of sloughs, and the processes of repair after severe burns, take place slowly; and as a rule the patient suffers much more acutely, and during a much longer period, than after other forms of injury involving equally extensive destruction of tissue.

The *constitutional* effects of burns and scalds vary with the superficial extent and situation, rather than with the depth of the injury. Thus an extensive burn or scald over the abdomen affecting only the skin is much more likely to prove fatal than a deep burn of one of the extremities, penetrating even to the bone, but of comparatively small superficial area. If more than half the surface of the body is affected the sufferer rarely recovers.

Death may result from shock to the system, either immediately on receipt of the injury, or after a period of from two or three to forty-eight hours or more. During this time the sufferer remains in a state of collapse or prostration, with pallor of complexion, lowness of temperature, coolness of breath, small or imperceptible pulse, dryness of tongue and mouth, and sometimes delirium, rigors, or convulsions. In such cases, *post-mortem* examination shows only congestion of the viscera, and especially of the brain. In some instances, characterised by painfully laboured and frequent efforts at respiration, tumultuous, irregular, feeble and very frequent action of the heart, and great præcordial distress, death would appear to be due to cardiac thrombosis, rather than to simple nervous shock (Brown). In many severe cases the blood has been found on microscopical examination altered in appearance, the red corpuscles being separated into 'numerous little bits' (Ponfick and Schmidt). And it is readily conceivable that such destruction of corpuscles may give rise to severe symptoms, or even cause death.

In about forty-eight hours, more or less, if the immediate effects of the injury have been survived, the stage of reaction and inflammation sets in. The patient revives, and some degree of general pyrexia becomes manifest. The pulse becomes quicker and fuller; the temperature rises; and the burnt part begins to discharge pus, usually of an offensive odour. Thirst, with dry red tongue, want of appetite, vomiting and constipation, followed by diarrhœa—sometimes with blood in the evacuations—are commonly experienced during the ensuing period and inflammation of internal parts often occurs, although the special signs and symptoms afforded may be obscure. The pleuræ and lungs, the peritoneum, and the gastro-intestinal mucous membrane (particularly that of the duodenum) are especially liable to be affected. Evidence of inflammation of one or more of these parts, and not uncommonly of ulceration of the duodenum, is afforded on *post mortem* examination in cases in which death has occurred during this period. It has been suggested that capillary embolism, from the presence of disintegrated blood in the vessels, may cause in some cases the lesions of the internal organs (Brown).

In the course of about a fortnight after the injury, as a general rule, the sloughs will have separated, the acute symptoms will have subsided, and granulation and suppuration will have been established. But a low form of chronic inflammatory mischief in the internal organs may still be going on, and lead to fatal result; or the patient may sink, worn out by suffering, and exhausted by the profuse discharge from the suppurating surface, or by persistent diarrhœa, accompanied or not by blood in the motions. Sometimes the kidneys are affected, and blood or bloody casts may be found in the urine. Pyæmia, erysipelas, or tetanus may occur and cause death; but there would not appear to be any special liability to these diseases after burns or scalds.

TREATMENT.—*Local treatment.*—Slight superficial burns of small extent require little in the way of treatment. Immersion in cold water according to some, in hot water according to others, or exposure before the fire, affords the readiest means of obtaining immediate relief. Afterwards the part may be covered with flour, starch, oxide of zinc, bismuth, or collodion, and wrapped round with cotton-wool to protect it from the air and from accidental irritation. In cases in which there is vesication, the blisters should be pricked, the serum evacuated, and the cuticle left to form a natural protective covering, which may be advantageously strengthened and kept in position by a layer of collodion. But the punctures should be left open. Lint soaked in oil, or smeared with vaseline or some such material, should be applied, and the whole covered with cotton-wool. A mixture of chalk or whitening and vinegar, of the consistence of thick cream, is said to form an excellent application in such cases, speedily relieving pain, and helping to constitute a good protective covering.

Severe and extensive burns and scalds demand in their treatment the most careful management, and the greatest possible patience, gentleness, and firmness; for even if life be preserved, the most pitiable disfigurements and

deformities are liable to result from cicatricial contractions, unless proper preventive measures are perseveringly carried out. So soon as may be after the injury, the clothes should be removed from the patient with the greatest care —being cut away piecemeal if needful, and not removed in such way as to tear off epidermis or scorched or charred parts. The whole burnt surface should then be covered as quickly as possible with the dressing considered best, and enveloped in thick layers of cotton-wool lightly bandaged on. Different dressings have been advocated from time to time, but probably there is none better, or more generally and readily applicable in hospital practice at any rate, than Carron oil (a mixture of equal parts of linseed oil and limewater). The addition of a little carbolic acid is advantageous. A less disagreeable application may be made by substituting olive or almond oil for linseed oil. White lead, putty made thin by addition of oil, calamine ointment, carbolised oil, solution of carbonate of soda, carbolic lotion, flour, and starch, are among the other materials that have been recommended. Whatever the material selected, it should be slightly warmed, and applied very thickly spread on broad strips of lint in such way as to facilitate future dressing bit by bit, and so as to avoid extensive exposure of raw surface. The first dressing should be allowed to remain undisturbed as long as possible—until, indeed, the offensiveness of the discharge, or the discomfort of the patient, indicates the necessity for its removal. The earlier dressings, however gently carried out, occasion so much suffering to the patient that—in the case of children especially—it is often desirable to administer chloroform. Poultices are sometimes useful in aiding the separation of sloughs. Any needful washing or cleansing is best done by aid of the steam spray-producer, a weak solution of carbolic acid or of borax being used. When suppuration is established, and the surface clean, the application may be varied according to the indications afforded. Calamine or zinc or lead ointment, with or without the addition of some anodyne; and lotions of lead, morphia, and glycerine, or of sulphate of zinc, are amongst those commonly employed. Iodoform, with extract of hemlock and spermaceti ointment, has been strongly recommended as tending to soothe pain, to deodorise the discharge, and favour healing. Exuberant granulations may be treated with nitrate of silver in solution, or by the application of the solid stick. When the granulating surface is in a healthy state, cicatrisation may be very materially expedited by skin-grafting.

During cicatrisation, and even for some time afterwards, it is of the greatest importance to keep all parts in such position as that there shall be as little deformity as possible from growing together of surfaces, and contraction of scars. This is to be effected or attempted by position, by mechanical apparatus, and by the application of strips of adhesive plaster and bandages in manner determined by the circumstances and conditions in each particular case.

Constitutional treatment.—In the early stages, alcoholic stimulants, or ammonia, and external warmth are especially requisite, and such light nourishment as can be taken. Opiates or other anodynes, as chloral or bromide of potassium, are to be administered according to the indications afforded, for the purpose of allaying pain and soothing the nervous system. When suppuration is established, a full allowance of good nourishing food, with some alcoholic stimulant, should be given, and such tonics as seem most suitable. Small doses of opium at regular intervals often prove very beneficial. The complications that may arise, such as affections of the internal organs, &c., must be treated in accordance with general principles, but all depressing medicines as a rule should be avoided.

ARTHUR E. DURHAM.

HEAT, Therapeutics of.—PRINCIPLES.—The primary effect of external heat applied *locally* to the animal body is that of an excitant or stimulant. There occurs redness with turgescence of the small vessels, in the part to which the heat is applied, along with slight augmentation of temperature, and pain. Increased beyond a certain degree, heat ceases to be a stimulant, its prolonged action causing greater pain, exhaustion, depression, and, if the action be very intense, decomposition of the organized tissues. *See* preceding article.

Experiments have shown that by increased heat the electric currents in the nerves are destroyed. It may therefore be assumed that the nerves become less able to conduct impressions either to or from the brain, and that heat may act as a sedative to painful nerves.

Moderate heat applied generally, that is, to the whole body, produces a number of important physiological effects which are fully described in the preceding article, to which the reader is referred.

APPLICATIONS AND USES.—Heat is employed in the treatment of disease as a general or local stimulant, a local depressant, a caustic, or a counter-irritant; and that in the form either of *dry* or of *moist* heat.

Dry heat.—The primary exciting and stimulating action of heat may be made available to rouse the nervous and vascular systems. The use of the hot air bath (Turkish Bath), and that of the sand-bath are discussed in the article on BATHS. In some parts of the South of France, baths of hot sand (*arena calida*) are used in the treatment of rheumatism, paralysis, and spasm; the sand acting as a stimulant and sudorific. To restore the circulation, bottles of hot water are placed in the axillæ, and against the feet and thighs, in cases of collapse of the system, with coldness of the extremities and great failure of circulation, as in the treatment of collapse from the shock of an injury, or from such diseases as cholera, or of the apparently drowned.

Dry heat may also be applied to the abdomen, in the form of tins or bottles of hot water, or bags of heated salt or sand, to relieve painful spasm and colic. Hot water enclosed in an india-rubber bag is sometimes of service to allay undue irritability of the spinal nerves. The therapeutical application of heat as a counter-irritant will be found described elsewhere. *See* COUNTER-IRRITANTS.

Moist heat. – Heat and moisture together tend

to cause relaxation of the tissues, thus removing the tension and pain due to inflammation. Moist heat is employed locally in the form of the local vapour bath, fomentations, and poultices. *See* FOMENTATIONS; and POULTICES.

Moist heat is applied to the surface of the body generally, chiefly in the form of the vapour bath. *See* BATHS.

JOHN C. THOROWGOOD.

HEAT-STROKE.—A synonym for sunstroke. *See* SUNSTROKE.

HECTIC FEVER (ἑκτικὸς, habitual).—SYNON.: Fr. *Hectique*; Ger. *Hectisch.*

ÆTIOLOGY.—The variety of fever thus named has long received special recognition, inasmuch as it presents certain prominent and peculiar features, as regards its course and attendant phenomena. It occurs in association with some wasting and exhausting disease, especially when this is accompanied by a profuse and constant drain from the system, and more particularly when there is chronic suppuration, with an abundant discharge of pus. Hectic fever is most frequently noticed in cases of pulmonary phthisis, in a large proportion of which it appears in various degrees during some part of their course, chiefly in the advanced stages. Other conditions deserving of mention in connection with which it may supervene are empyæma, especially if there is an external fistula, tubercular ulceration of the intestines, chronic purulent discharge from the kidney, hepatic abscess, chronic dysentery, and any form of external chronic abscess attended with much discharge. Fever of a hectic type sometimes occurs in cases of acute inflammation; and it is occasionally observed in chronic affections unattended with suppuration, such as cancer and lymphadenoma. Pathologically it seems to be connected with the absorption of pus or other morbid products into the blood. *See* FEVER.

SYMPTOMS.—Hectic fever is established gradually, becoming more and more distinct, until it assumes its typical characters. It is more or less paroxysmal, being at first indicated by slight pyrexia towards evening and during the night, the temperature being a little raised, and the pulse hurried. During the day there is no fever at this time, but as the case progresses it becomes constant, though exacerbations occur at night, and, it may be, also in the morning, the paroxysms thus occurring either once or twice within the twenty-four hours, and the pyrexia being remittent. In typical hectic there is a complete febrile cycle, beginning with chills or even a distinct rigor, followed by considerable heat of skin, the temperature continuing to rise, and ending in more or less profuse perspiration, especially about the head and chest, sometimes so abundant as to saturate the bed-clothes or even the bedding. Patients often feel subjectively very hot, the palms of the hands and soles of the feet having a burning sensation. The pulse tends to become very frequent and quick, and is easily hurried and excited, being at the same time weak, soft, and compressible. Not uncommonly a bright red or pink spot appears on each cheek during the paroxysm, known as the *hectic flush*, and this may contrast markedly with the general pallor of the face, the eyes being also bright, clear, and sparkling. The mind is unaffected, and the mental faculties may be unusually bright and vivid. After a febrile exacerbation the urine may present excess of lithates. Hectic fever does not always show all its typical features, and even in the same case variations are noticed in the precise characters of the paroxysms. It is usually accompanied with other symptoms due to the disease with which it is associated; while it itself tends to cause wasting and debility, as well as a sense of exhaustion after each attack. In most instances a fatal termination ultimately ensues, but if the condition upon which hectic depends is curable, recovery may take place.

TREATMENT.—The first principle in the treatment of hectic fever is to attend to, and cure, if possible, the condition upon which it depends, and especially to diminish or stop suppuration. General tonic treatment will also help in preventing the paroxysms. These may be directly checked in appropriate cases by full doses of quinine, salicine, or other antipyretics, given before the usual time for their occurrence. Sponging the skin freely may also prove of service in some instances. The treatment of hectic in phthisis runs into that of night-sweats, and can be more conveniently discussed under that disease. *See* PHTHISIS.

FREDERICK T. ROBERTS.

HELIOSIS (ἡλιόω, I expose to the sun).—A method of treatment for certain diseases, which consists in exposing the patient to the rays of the sun. The term is also employed as a synonym for sunstroke. *See* SUNSTROKE.

HELMINTHIASIS (ἕλμινς, a worm).—The condition of system upon which the development of worms in any part of the body depends. The term is also applied to the diseases characterised by the presence of worms.

HELMINTHICS (ἕλμινς, a worm).—Of or belonging to worms. A synonym for anthelmintics. *See* ANTHELMINTICS.

HELMINTHS (ἕλμινς, a worm). — This term is often employed in preference to one or other of the various synonyms with which it is regarded as equivalent (worms, intestinal worms, vermes, entozoa, internal parasites, and so forth). Thus, Von Siebold (who speaks of the Helminths as forming a *class* of animals, nearly all of whose members are parasitic) admits that the only character common to the greater part of the whole group is their peculiar mode of life. The study of the helminths forms what is often called the science of *Helminthology*. In accordance with professional custom, it has been thought desirable, in the present work, to speak of the helminths as constituting the class ENTOZOA, under which heading, therefore, more detailed references are given. T. S. COBBOLD.

HEMERALOPIA.—The etymology of this term is uncertain, and its real meaning has never been definitively settled. Some writers derive the word from ἡμέρα, *the day*, and ὤψ, *the eye*, and in conformity therewith, use it to signify *day-sight* or *night-blindness*, that is, a state of vision in which objects are seen by day-light or by strong artificial illumination, but become more or

less invisible when in deep shade or in twilight. Others, on the contrary, employ the term in the opposite sense of *day-blindness* or *night-sight*, deriving it from ἡμέρα, ὤψ, and ἀ, priv. or ἀλαὸς, *blind*. It is used in the latter sense in this work, and may, therefore, be defined as a disorder of vision, in which objects cannot be seen well or without pain by daylight or by strong artificial light, but are more clearly or comfortably seen in a deep shade or by twilight. *See* Vision, Disorders of.

HEMIANÆSTHESIA (ἥμισυς, the half; ὰ, priv.; and αἰσθάνομαι, I feel).—Paralysis of sensation affecting one side of the body. *See* Sensation, Disorders of.

HEMIANALGESIA (ἥμισυς, the half; ἀν, without; and ἄλγος, pain).—Insensibility to painful impressions, affecting one side of the body. *See* Sensation, Disorders of.

HEMICRANIA (ἥμισυς, the half, and κρανίον, the head.)—Pain limited to one side of the head. The term is, however, generally used as synonymous with megrim. *See* Megrim.

HEMIOPIA
HEMIOPSIA } (ἥμισυς, the half, and ὤψ, the eye).—A derangement of vision in which only one half of an object is seen by one eye. *See* Vision, Disorders of.

HEMIPLEGIA (ἥμισυς, the half, and πλήσσω, I strike).—Paralysis of motion of one side of the body; sometimes applied to loss both of motion and of sensation. *See* Paralysis, Motor.

HEPATALGIA (ἧπαρ, the liver, and ἄλγος, pain).—Strictly this word signifies pain in connection with the liver. It has, however, been specially applied to a supposed neuralgic pain referred to this organ, coming on in paroxysms, and said to be of a severe character in some instances, so as to simulate hepatic colic. Whether there is any such affection is exceedingly doubtful, and probably in cases of supposed hepatalgia the neuralgia is either superficial, or there is some tangible but undiscovered cause for the pain, connected with the liver or some neighbouring structure.

Frederick T. Roberts.

HEPATIC DISEASES. *See* Liver, Diseases of.

HEPATISATION (ἧπαρ, the liver).—A term applied to the condition produced by acute inflammation of the lung, in which the pulmonary substance becomes solid and friable, resembling somewhat the liver in its physical characters. *See* Lungs, Inflammation of.

HEPATITIS (ἧπαρ, the liver).—Inflammation of the liver. *See* Liver, Inflammation of.

HEPATOCELE (ἧπαρ, the liver, and κήλη, a tumour).—Hernia of the liver. *See* Liver, Displacements of.

HEREDITARY (*hæres*, an heir).—This term, as used in relation to medicine, is applied to the transmission of constitutional conditions, or of diseases, from parent to offspring. *See* Disease, Causes of; and Predisposition to Disease.

HERMAPHRODITE (Ἑρμῆς, Mercury, and Ἀφροδίτη, Venus).—A term applied to an individual in whom the formation of the sexual organs is such as to give rise to the impression that both the male and the female organs are present. *See* Malformations.

HERNIA (*hernia*, a rupture).—Definition. This word is used in surgery to express the protrusion of any viscus from the cavity in which it is naturally placed. In this article, however, the observations are exclusively restricted to protrusions of the viscera of the abdomen through the walls of that cavity, and it is only intended to give a mere outline of the subject, its full discussion being beyond the scope of this work, as it is mainly connected with surgery.

General Remarks.—Hernial displacements take place in both sexes and at all ages. The most striking objective sign of the existence of a hernia is a fulness or swelling in one or other of those regions of the abdomen where, from the anatomical construction of its walls, the tissues are weakest. When the parietes are defective, in consequence of local disease or injury, visceral protrusions may occur at those spots; and also, as the result of congenital malformation in both sexes, a fruitful cause of hernia being the non-closure of the vaginal process of the peritoneum at birth, or a patulous state of the umbilical aperture. Such a protruded viscus forms a hernial swelling or tumour. The tumour is composed of a sac, its contents, and the tissues outside the sac. The sac is composed of a prolongation of the peritoneum in most cases; and its orifice, neck, or abdominal aperture constitutes, with the tissues around it, a frequent cause of impediment to replacement or 'reduction' of the hernia. The hernia may be a part of any abdominal viscus, but those most mobile are usually displaced. Thus, in the majority of cases, either the omentum or small intestines, together or singly, form the hernia. The tissues outside the sac are those which exist in the region where the tumour is formed, and they are frequently described as the coverings of the sac.

Every hernial tumour possesses a neck, body, and fundus.

The first or earliest objective symptom of a hernial protrusion is an unusual fulness, as, for example, in the groin in a case of inguinal hernia. This swelling is transient, appearing and disappearing in relation to the actions or posture of the individual. When pressed with the finger the swelling disappears; but it is readily reproduced if the patient contracts the abdominal muscles, and then with the finger an impulse is felt, produced by the protruding viscus. By slow degrees the bulk of the swelling increases, until, if no support or 'truss' be used, very large tumours are formed.

Classification.—The most practical classification of hernial protrusions is based upon the usual triple division of the abdomen into regions, namely, the epigastrium, mesogastrium, and hypogastrium.

1. Protrusions in the epigastric region are very rare. They are (*a*) *Diaphragmatic*; and (*b*) *Epigastric*. The first is due either to relaxation of the

tissue of the diaphragm muscle, or to its laceration. In some cases congenital deficiency of the muscle is the primary cause; in others the natural openings in the muscle become dilated. Signs of this hernia are very obscure; but when the protrusion depends upon laceration of the muscle, the occurrence of a recent injury may excite suspicion, when associated with abnormal sounds in the thorax.

Epigastric hernia escapes at the region formed by the cartilages of the false ribs on either side of the linea alba. It is very rare, and as the abdominal orifice of the sac is usually large, the hernia is easily reduced.

2. The hernias in the mesogastrium are (*a*) *Ventral*; (*b*) *Umbilical*; and (*c*) *Lumbar*. The term *ventral* is given to any hernial protrusion escaping through abnormal openings in the walls of the abdomen, to which no special name is given. They are seen in the region of the linea alba, above the umbilicus, but most frequently below; in the line of the linea semilunaris; and even opposite the muscular walls. Commonly of traumatic origin, their nature is clearly shown by the ready manner in which the protruded viscus can be pressed back into the abdomen. They sometimes ensue upon the weakening of the walls after distension, or upon the loss of tissue following abscess.

Umbilical hernia is met with at all ages and in both sexes. It forms a tumour at the site of the umbilicus in the first instance, and gradually descends over the linea alba as its bulk increases. Very soon after birth this variety of hernia appears. The protrusion takes place at the umbilical ring, and pushing before it the peritoneum, an acquired hernial sac is formed. To prevent, therefore, the development of the sac in infancy, and to assist the closure of the ring in the linea alba, a slightly convex disc of cork, enclosed in washleather, should be strapped over the umbilical aperture. The prognosis of infantile umbilical hernia is favourable, for the aperture closes with age, and the tissues continue firm.

In adult life this kind of hernia is frequent in fat individuals. The tumour often acquires enormous proportions. Its contents consist of small intestine and omentum, with not uncommonly a portion of the transverse colon. Accumulations of fæcal matter therein often give rise to obstruction, and the symptoms arising in consequence of this state more or less resemble those of strangulated small intestine. A correct diagnostication of their cause may usually, however, be arrived at from the history of the attack, the comparative mildness of the malady, and the alleviation of the symptoms by exciting the action of the bowels. The contents of this form of hernia, when of long standing, often become adherent or bound by bands to the sac, in which state they remain permanently irreducible.

When the protruded viscus can be entirely reduced within the abdominal cavity, a suitable, well-fitting truss should be worn constantly, and, if irreducible, one adapted to the circumstances of the case must be used.

Lumbar hernia takes place in the loins. It is a very rare variety, and usually occurs as the result of an injury.

3. The herniæ in the hypogastrium are the most numerous and the most common. They include (*a*) *Inguino-scrotal* or *Inguino-labial, above* Poupart's ligament; (*b*) *Femoral, below* Poupart's ligament; (*c*) protrusions through the apertures of the pelvis in front, beneath the horizontal ramus of the pubes—*Obturator*; (*d*) beneath the arch of the pubes—*Perineal*; (*e*) *Pudendal*; (*f*) *Vaginal*; and (*g*) behind, through the ischiatic notch—*Ischiatic*.

Inguinal hernia is seen at all ages and in both sexes. The following varieties are described—the *oblique* or *external*; and the *direct* or *internal*. In the first, the orifice of the sac is outside the course of the internal epigastric artery; in the second it is internal to the same vessel. When the protrusion forming an inguinal hernia does not descend below the inguinal canal it is termed a *bubonocele*; but when it occupies the scrotum or labium it forms an *inguino-scrotal* or *inguino-labial* tumour. The essential difference between the inguinal hernia of youth and of middle age is due to the constitution of the sac which encloses the protrusion. From infancy to early adult life protruding viscera escape from the abdomen into a serous sheath, continuous with the parietal peritoneum, the vaginal process of that membrane, which extends into the scrotum or labium. In middle life and afterwards the parietal peritoneum is thrust through the apertures or weak points in the abdominal walls by the protruding viscus. In this way two distinct kinds of hernial sac are formed; the first being due to a congenital defect; the second, to a mechanical and acquired cause. In practice, it is very important to bear these distinctions in mind. In the first kind a truss is applied to prevent the passage of the viscus into the sheath, in the hope that by this means its walls may unite and its orifice contract—in fact, to assist nature in accomplishing that condition the failure of which permits the protrusion to take place. But, in the second, a truss is used to prevent the protruding viscus pushing the peritoneum before it and so forming for itself a sac. Thus, if the development of the sac be arrested, there can be no hernial tumour.

Inguinal herniæ occupy the inguinal canal, and are, therefore, in relation with the spermatic cord of the male and the round ligament of the female. They escape from the canal through the external abdominal ring into the scrotum or labium. The neck of the tumour is always therefore above Poupart's ligament, and to the inner side of the external pillar of the external abdominal ring. This anatomical fact constitutes the main distinction between inguinal and femoral hernia.

Femoral hernia forms a tumour at the inner and upper part of the thigh, immediately below the pubic attachments of Poupart's ligament. Those structures are in immediate relation with the neck of the sac. The protrusion escapes at the femoral aperture, the site of the entrance of the lymphatic vessels of the thigh to the abdominal cavity. The neck of the sac is therefore to the inner side of the sheath of the femoral vessels, although, in proportion to the bulk of the tumour, its body may overlie it, and even extend upwards above Poupart's ligament.

and outwards towards the crest of the ilium. The sac of a femoral hernia is always an acquired formation. Hence the importance of wearing a truss after observing the slightest indication of a femoral protrusion. For if the yielding, relaxed, parietal peritoneum be supported at the crural aperture by a well-adjusted pad, a visceral hernia must be avoided, as there will be no sac into which it can escape. In other words, arrest the development of the sac and there can be no hernia.

To discriminate between a femoral and an inguinal hernia, place the index finger upon the spinous process of the pubes; if the neck of the tumour is to its outer side, and the whole length of Poupart's ligament can be traced above it, a femoral hernia exists. Should precisely the converse conditions be ascertained, the tumour will depend upon an inguinal protrusion. Another method for diagnosis is the direct and careful examination of the site of the femoral aperture. If it is clearly and distinctly tangible and well-defined, it cannot be occupied by a hernial protrusion.

This hernia is most common in the adult female. It has been developed before ten years of age, is rare between that age and twenty, but very frequent in persons between twenty and forty years old. Prolific women are more frequently the subjects of this hernia than the single and sterile.

Obturator hernia escapes from the pelvis through the thyroid foramen, and traverses the canal normally occupied by the obturator nerve and vessels. It is rarely met with. A fulness, rather than a tumour, is produced by the protrusion at the inner or pubic region of the thigh, beneath the pectineus muscle, and accompanied by a peculiar numbness and pain, which may be traced to the distribution of the filaments of the obturator nerve. The lives of patients have been lost in consequence of overlooking these herniæ; the cause of death being only ascertained *post mortem*.

Perineal, pudendal, vaginal, and *ischiatic* hernias are very rarely seen. The name assigned to each indicates the locality in which the tumour is formed, and for a special description of them, the reader must be referred to monographs on the subject of this article.

Effects and Treatment.—We must next, as briefly as possible, describe generally the various morbid conditions which the hernia itself may undergo, and the means by which fatal consequences from such conditions may be averted.

All hernial protrusions are reducible or irreducible; that is, they can be restored to their normal situation, or they may be permanently confined to the region in which they are protruded.

The treatment of all reducible herniæ consists in the employment of means to prevent the escape of the protrusion. To effect this object various kinds of bandages or trusses have been devised. Each kind of hernia requires its special form of truss, and every individual should, as far as practicable, obtain a truss well fitted to his or her configuration. The essentials of a good truss consist in the spring having sufficient power to support the hernia and prevent its escape, while it should not be so strong as to injure the structures about the abdominal rings. The pad should be firm, of a shape suitable to the case, and of a size not inconvenient to the wearer.

The irreducibility of a hernia depends on its bulk, adhesions, and special anatomical conditions. Under such circumstances special bandages must be employed.

But other much more important morbid states of the protruded viscus than the above, cause impediments to the reduction of a hernia, namely—1, constriction by the tissues around the orifice of the sac; 2, accumulation of fæcal matter in the protruded viscus; 3, inflammation of the hernia; and 4, strangulation when a part of the alimentary canal forms the hernia.

1. Those herniæ—for example, the inguinal—which pass through openings in the muscular walls of the abdomen, are liable to constriction from contraction of the muscular tissue. Inguinal herniæ of long standing, and more than ordinary bulk, are very prone to become irreducible in consequence of muscular contraction. Such cases are well adapted to illustrate the effects of anæsthetics, and their influence on muscular irritability. If the patient be placed under the full influence of chloroform, the abdominal muscles become relaxed, and the hernia quickly reduced.

2. Those hernial protrusions formed of large intestine, such as occur at the umbilicus, frequently become irreducible from accumulations of stercoraceous substances. In these cases enemata, and even purgative medicines, frequently relieve the symptoms.

3. Inflammation excited in an omental protrusion may cause temporary and even permanent irreducibility. Local and constitutional symptoms of a rather severe type sometimes attend such cases. The usual methods adopted to induce resolution must be employed.

4. A morbid state of the protruded bowel termed *strangulation* has next to be described. A patient the subject of this state remains in the greatest danger to life so long as the exciting cause, the constriction of the bowel, exists. Hour by hour that danger increases, and although rare instances of recovery might be quoted after the continuance of strangulation for many hours, the majority of patients die because the intestine was not liberated early enough. A hernia is described as strangulated when subject to a constriction which at first impedes, and sooner or later arrests the circulation of the blood in its capillary vessels. The passage of stercoraceous material is necessarily stopped. The local and constitutional symptoms are strikingly characteristic. Very frequently the first symptom is vomiting, unaccompanied by any alvine evacuation. The vomiting continues, and is excited by ingesta. This state is probably due to mere obstruction of the alimentary canal, but it ought always to excite the anxious solicitude of the medical attendant, to ascertain whether the patient has any outward signs of a hernial tumour. He must examine those regions at which protrusions commonly occur, and never rest content with the statements of the sufferer. At first the pulse is not affected in a very marked way, but as vomiting continues the heart beats more

rapidly, whilst the pulse becomes weaker and contracted. The surface, especially that of the extremities, becomes cold; the countenance aged and anxious; the visage, lips, and hands shrivelled and bluish; the prostration extreme. The tumour is painful when touched, and it may have increased in size and become tense. All these facts indicate progressive morbid changes in the tissues of the strangulated bowel, as well as in that part of the alimentary canal above the hernia. Besides the mere act of vomiting all ingesta, the characters of the fluid vomited must be carefully noted. Usually, at first, it is the food last swallowed, more or less digested and mingled with bile; in the second stage it becomes yellowish and greenish; and at last it is stercoraceous, that is, offensive to smell, of a brownish colour and frothy, and often in great quantity. Now the only treatment of these urgent symptoms consists in the liberation of the bowel by surgical means. In the mean time palliatives may be employed, opium administered by the mouth, enemata injected, local applications of ice used, and gentle taxis applied.

JOHN BIRKETT.

HERNIA CEREBRI. *See* BRAIN, Malformations of; and SKULL, Diseases of.

HERPES (ἕρπω, I creep). SYNON.: Fr. *Herpès*; Ger. *Flechte.*

DEFINITION.—A term applied to an eruption of vesicles on an inflamed patch of integument.

ÆTIOLOGY.—A *predisposing* cause of herpes is the gouty or rheumatic diathesis. It is often *excited* by chill or by irritation of a mucous membrane—of the air-passages in the case of herpes labialis, and of the urinary passages in herpes præputialis.

VARIETIES AND SYMPTOMS.—The commonest forms of this disease are *herpes zoster, herpes labialis*, and *herpes præputialis*; to which may be added *herpes facialis, herpes collaris, herpes cruralis*, and so forth. In herpes labialis and præputialis, the inflamed patch is generally single; but in the other forms the patches may range from five to ten in number, and vary in size from a small blotch, scarcely an inch in diameter, to one of three or four inches. The patches follow the course of distribution of the nerves; and on the trunk of the body form a kind of festoon, extending from the spine behind to the middle line in front. This is especially the case in herpes zoster, likewise called *zona* and *shingles*, where the blotches, following the course of one or more intercostal nerves, form a half belt or circle around the waist. The eruption of herpes is unilateral. It has a regular course of from ten to twenty days.

The vesicles of herpes are developed in groups, ranging in number from two or three to twenty or thirty, and in size from that of the head of a pin to that of a small pea. The fluid contained within them is at first transparent; it then becomes opalescent, opaque, purulent, and sometimes purplish from admixture with blood; and finally the eruption terminates in a scab more or less dark-coloured, and more or less deeply imbedded in the skin, which often leaves at its fall a permanent cicatrix.

Herpes is accompanied with a burning, tingling, and pricking sensation, and occasionally with severe neuralgic pains. The neuralgia may either precede or follow the eruption; and occasionally it is intense and of long duration. *See* Dr. Sangster; *Lancet*, vol. i. 1882.

TREATMENT.—The treatment of herpes is both constitutional and local. In slight cases, as the eruption runs a regular course, and tends to spontaneous cure, no *constitutional* treatment is necessary. If thought desirable, treatment should be restricted to regulating the digestive and assimilative functions; strengthening nerve-power; and, where severe pain or neuralgia is present, administering quinine or sedatives. *Locally*, dredging with flour or some absorbent powder affords relief; and especially the application of a lotion of oxide of zinc and lime-water. Over these should be placed a sheet of cotton-wool; and the latter must be kept in place by means of a light bandage. In very painful cases, the subcutaneous injection of morphia may be required, or the application of anodyne liniments.

ERASMUS WILSON.

HETEROLOGOUS (ἕτερος, other, and λόγος, nature). — A word used to characterise any morbid product, whether fluid or solid, which is different in composition or structure from the normal fluids or solids of the body.

HETEROMORPHOUS (ἕτερος, other, and μορφή, form).—Applied to new formations which are different in form and structure from the normal tissues.

HETEROTOPOUS (ἕτερος, other, and τόπος, a place).—Misplaced. A term applied to the appearance either of a normal tissue in an unnatural situation—for example, of hairs on mucous surfaces; or of morbid growths in unusual places—for instance, of epithelioma in nervous tissue.

HICCUP or HICCOUGH.—SYNON.: *Singultus*; Fr. *Hoquet*; Ger. *der Schlucken.*

DESCRIPTION.—Hiccup, according to physiologists, is a sudden spasmodic descent of the diaphragm accompanied by a spasmodic closure of the glottis, the characteristic noise being caused by the incoming column of air striking against the partially closed glottis. The assumption of a spasmodic closure of the glottis in hiccup seems scarcely warrantable. Normally the descent of the diaphragm in each respiratory act is accompanied by a contraction of the posterior crico-arytænoid muscles, which causes an outward rotation of the arytænoid cartilages, and a dilatation of the glottic aperture. The diaphragmatic and the laryngeal acts keep time together, and in health the rhythm of sixteen or eighteen to the minute is maintained. If, however, the diaphragm give a sudden descending jerk irrespective of any respiratory need, as is the case in hiccup, and this jerk occur at a time when the dilators of the glottis are not acting, a noise will be produced by the rush of air through the insufficiently widened glottic aperture. It seems certainly possible to account for the noise of hiccup by the mere fact of the descent of the diaphragm occurring when the glottis is not properly open. The noise is not a constant phenomenon, and during an attack of

hiccup it never occurs during ordinary inspiration, or without the spasmodic action of the diaphragm, although the latter phenomenon may occur without the former.

ÆTIOLOGY.—Hiccup may be produced by any irritation of the phrenic nerve—its origin, its course, or the ultimate twigs which are distributed to the under surface of the diaphragm. Undue distension of the stomach by being overfilled with food or drink, or by an accumulation of wind due to faulty digestion, is the most common cause of hiccup. Its occurrence from this cause is far more common in children than in adults. Convulsions and muscular spasms generally are more easily caused in the young, and hiccup in this respect follows the ordinary rule. Hiccup is produced by direct, or by reflex irritation. With many persons the introduction of hot spiced or peppery foods into the stomach immediately produces hiccup, and the writer knows one or two persons in whom hiccup is produced by the passage of hot fluids through the pharynx. It is a frequent symptom in peritonitis when the peritoneal covering of the diaphragm becomes affected. It sometimes occurs in cases of cancer of the stomach; occasionally, perhaps, from overdistension of the organ, but more often from an extension of the cancerous disease to the peritoneal surface of the stomach. It is occasionally a troublesome symptom during convalescence in cholera, and is often accompanied by eructations of wind, and sometimes by vomiting. If hiccup occur with any persistency in the course of typhoid fever, it is often an indication of perforation and the onset of general peritonitis. Although most frequently a symptom of gastric or abdominal disturbance, hiccup occasionally occurs as a true neurosis. It may accompany hydrocephalus or meningitis, and is then due probably to an implication of the cerebral origin of the phrenic nerve. Cases of obstinate hiccupping in hysterical subjects have been recorded, and cases of paroxysmal hiccup have been observed by Liveing, Prichard, and others, which have been regarded as instances of modified epilepsy.

TREATMENT.—The treatment of hiccup will depend upon the cause. An emetic to empty the stomach, or a stimulant to increase its natural peristaltic action, will often give relief. If we can succeed in producing a forcible action of the diaphragm, we may often succeed in curing it, as it were, of the trick of spasmodic action. Attempts to count a hundred without drawing breath, or to hold the breath for a minute, are familiar remedies for hiccup, and, by producing a feeling of suffocation, and necessitating a violent descent of the diaphragm, they are often successful. Warm applications or counter-irritation applied to the diaphragmatic region or over the cervical spine, may occasionally give relief. Pressure upon the trunk of the phrenic nerve by means of the finger applied over the scalenus anticus muscle, is said also to have given relief occasionally in obstinate cases. Amongst the drugs which have been recommended for the relief of hiccup are chloroform (administered internally), either alone or combined with opium, camphor in the form of a spirit solution, in doses of twenty drops and upwards, valerianate of zinc, belladonna, bromide of potassium, musk, antacids, and in very severe cases morphia administered hypodermically. G. V. POORE.

HIPPURIA (*ἵππος*, a horse, and *οὖρον*, urine).—The condition of the urine in which it contains hippuric acid in excess. *See* URINE, Morbid Conditions of.

HISTRIONIC SPASM (*histrio*, an actor). A synonym for facial spasm, so called on account of the contortions of the face to which this affection gives rise. *See* FACIAL SPASM.

HIVES.—A popular term for chicken-pox. *See* CHICKEN-POX.

HOARSENESS (Sax., *has*, having a rough voice).—Roughness of the voice, due to disease or disorder connected with the larynx. *See* VOICE, Disorders of.

HOBNAIL LIVER.—A name given to a cirrhotic liver, when it presents small prominences on its surface, resembling hobnails. *See* LIVER, Cirrhosis of.

HODGKIN'S DISEASE.—A synonym for Lymphadenoma. *See* LYMPHADENOMA.

HOMBURG, in Germany. Common salt waters. *See* MINERAL WATERS.

HOMICIDAL INSANITY. *See* CRIMINAL IRRESPONSIBILITY; and INSANITY, Impulsive.

HOMOLOGOUS (*ὁμὸς*, like, and *λόγος*, nature).—In pathology this term is applied to new growths presenting the same structure as normal tissues, such as fatty or fibrous tumours.

HOOPING-COUGH. *See* WHOOPING COUGH.

HORDEOLUM (*hordeum*, a barley-corn). A synonym for stye. *See* STYE.

HORN-POX.—A popular term for a variety of chicken-pox. *See* CHICKEN-POX.

HORNS.—SYNON.: *Cornua.* DEFINITION.—Horns are epidermic and epithelial formations, consequent on hypertrophy of the horny product of the integument.

DESCRIPTION.—Horns generally occur singly. Sometimes they attain a size of several inches in length and in circumference. They have been met with on all parts of the body, more particularly on the scalp, the face, the glans penis, and the glans clitoridis.

PATHOLOGY.—When the inspissated product of the follicles of the skin, consisting of laminated epithelium and sebaceous matter, is exposed to the air, it dries, becomes hard and transparent, and is in fact converted into a mass having most of the properties of horn. This is the principal source of the horns of the integument—an accumulation of the contents of a follicle; the protrusion of that substance through the dilated aperture of the follicle, sometimes through a large opening resulting from atrophy or ulceration; its dessication by the atmosphere; and its growth by continued additions to its base. Being essentially the protrusion of a soft substance through a constricted aperture, the surface of the

horn will be modelled in figure by the shape of that aperture; in consequence of desiccation, its shaft will be smaller than its base; and it will be liable to be bent or twisted in the operation of protrusion. Hence these horns are generally curved or twisted, and have been compared to the beak of a bird, or the horn of the goat. A section of the horn affords similar evidence of its manner of formation and growth, it being always laminated in structure.

Another kind of horn is sometimes met with on the glans penis and clitoridis, and is the product of hypertrophy of the papillæ. This form of growth is fibrous in structure, like a wart, which in fact it closely resembles; whilst in the same situation concreted masses are occasionally formed, constituted by a combination of both processes, namely, papillary hypertrophy and accumulation of follicular substance. There is, however, an important difference between the two kinds of horn, the sebaceous and the epidermic, namely, that the former is the mere result of increased activity of function, whilst the latter is the consequence of hyperæmia or inflammation.

Treatment.—Horny matter being susceptible of disintegration by moisture, the sebaceous horn may be so thoroughly softened by envelopment in a waterproof covering, or by a poultice, as to be easily broken away at its base. The follicular bed from which it has been removed may then be cleared by a small scoop, when the sac will contract and close. Sometimes it may be thought desirable to sponge the surface with a solution of chloride of zinc or sulphate of copper; but operation by the knife seems quite uncalled for. In the instances of epidermic and epithelial horn, however, it will be necessary to have recourse to caustics, especially potassa fusa; and when the case evinces great obstinacy, or where an epitheliomatous degeneration is suspected, the use of the knife becomes essential.

Erasmus Wilson.

HORRIPILATION (*horreo*, I bristle up, and *pilus*, a hair).—A sensation of chilliness and creeping, the hairs appearing to stand on end.

HOSPITALS.—The subjects having relation to hospitals will be treated of under the following heads:—I. Hospitalism; II. Hospitals, Administration of; III. Hospitals, Construction of; IV. Nursing; and V. Nurses, Training of. The reader is referred to these several articles.

HOSPITALISM.—The term 'Hospitalism' was introduced into medical literature by Sir J. Simpson (*Edinburgh Medical Journal*, March, 1869), but, as far as the writer can see, no exact definition of it was given by its author. It, however, was evidently intended to signify 'the hygienic evils which the system of huge and colossal hospital edifices has hitherto been made to involve'—to use Sir J. Simpson's own words. These evils appeared to him so evident, and so necessarily connected with the size of the hospital, that he taught (and in fact the sole object of his papers was to teach) that our system ought to be revolutionised—'hospitals changed from being crowded palaces, with a layer of sick on each flat, into villages or cottages, with one, or at most two patients in each room—the village constructed of iron instead of brick or stone, and taken down and rebuilt every few years.'

Mr. Erichsen has, to some extent, accepted the teaching of Sir J. Simpson, though he allows that some of it is very questionable. His tract on the subject of Hospitalism has the advantage of being written in a more sober style than Sir J. Simpson's, and also of putting the question in a clearer light.

By the term, he says, 'is meant a general morbid condition of the building, or of its atmosphere, productive of disease. . . . Doubtless,' says Mr. Erichsen, 'all the septic diseases that are met with in hospitals may be encountered in the practice of surgeons out of these institutions, but they are unquestionably infinitely more common in hospital than in private practice, and their causes are certainly different.'[1] The writer believes, on the contrary, that if a hospital be properly managed there is no general morbid condition of the building—that there is no reason for thinking that septic diseases are more common relatively in hospitals than out of them, and that their causes are identical wherever they occur.

And if the term Hospitalism is to be taken in the sense in which Sir J. Simpson evidently intended, that is, as meaning to convey the idea that there is an inevitable tendency to the generation of septic disease in large hospitals, that that tendency becomes greater as the size of the hospital is increased, and that it increases as the hospital grows older, the writer has no hesitation in saying that there is no such thing as Hospitalism. No doubt the aggregation of the sick and wounded in hospitals is a cause of danger, and much care and vigilance is required to keep hospitals healthy. But the dangers are in no sense peculiar to hospitals. The surgical affections which spring up in hospitals—erysipelas, phagedæna, pyæmia, and allied affections—all of them prevail in private practice, and, as far as has been shown, prevail equally.[2] Further, although the perfect publicity of our hospital practice enables us to obtain tolerably accurate data for a comparison of the experience of the smaller and larger hospitals of this and other towns, no one has ever seen the least reason for believing that the smaller are in any respect healthier than the larger, while several of the hospitals that have been longest built are renowned for their healthy condition, and in many large hospitals, parts of which are ancient and other parts modern, the former, if equally or better constructed, are (under similar conditions of cases and management) as healthy or more healthy than the parts more recently built.

The subject is not one which can be passed over as dealing with an insignificant question, or one of verbal interest only. The doctrines which Sir James Simpson taught led him to deprecate

[1] *On Hospitalism*, p. 37.

[2] It is not, of course, meant that pyæmia, for instance, is seen as often in private as in hospital practice, because its causes are less often met with in the former than the latter; but, if due allowance be made for this obvious consideration, there is much reason to acquiesce in the conclusion to which Sir J. Paget's ample experience has led him, that pyæmia is just as frequent in private as in hospital practice (*Clin. Soc. Trans.* vol. vii. p. lvi.). Erysipelas seems to be more frequent and more fatal at the present time in London private practice than in hospitals.

altogether the construction of any hospital of considerable size, and to advocate some extravagant scheme for substituting small detached temporary sheds for our present permanent hospitals. The same views led Mr. Erichsen to say that when a hospital had become, as he phrased it, 'pyæmia-stricken,' it ought to be destroyed,[1] while similar ideas have led others, such as Dr. Farr and Miss Nightingale, to question whether hospitals had not destroyed more lives than they had saved. Such doctrines should not be passed over in silence, since they exercise a great influence on the public, on whose co-operation the efficiency of our hospital system is to a great extent based. And certainly a theory which has received the support, however qualified, of so eminent a hospital surgeon as Mr. Erichsen, cannot be considered as of no importance.

It is therefore necessary to point out to the reader that the theory, as so stated (and stated quite correctly after Sir J. Simpson's writings), is utterly disproved by the experience of all well-managed hospitals, both before and after the introduction of the antiseptic method of dressing wounds. It must be noticed, in the first place, that the basis of the theory was entirely what is called 'statistics,' that is, a hasty inference from figures, showing the results of a large number of cases on either side. Now nothing is more dangerous than to draw conclusions from such figures, which are quite unsupported by any histories of the cases on which they are founded.[2] The success of a surgical operation depends more on the antecedents of the operation than on its consequents, and the healthiness of hospitals depends far more on other circumstances than on their construction, size, or age. Nay more, the success of surgical operations does not necessarily vary with the healthiness of the hospital. In the healthiest hospital a careless surgeon, house-surgeon, or nurse may make havoc of the major operations while all is going on well with the general run of patients.

For all these reasons, any one of which would be sufficient, the conclusions of Sir J. Simpson are to be utterly repudiated, and to be considered the more mischievous because, while they allege imaginary causes of danger, they thereby conceal those which are real and certain, and necessarily induce surgeons and managers of hospitals to overlook details, attention to which is always followed by success in the treatment of grave surgical cases, and by a condition of hospital hardly if at all inferior to the best circumstances under which private practice is carried on.

The writer must not be misunderstood, as if he thought the details of hospital-construction unimportant. The principles of construction which are now accepted for the building of a hospital will be found at pp. 647–652; but it has been shown to demonstration that, provided wards be well, but not excessively, ventilated, and kept perfectly clean, and provided the beds are far enough apart, the precise ground plan of the hospital matters little—that the doctrines so much insisted on by the French writers on hospitals as to the superiority of the 'pavilion plan,' as to the unhealthiness of upper storeys and so on, and which have been adopted as if they were unquestionable truths by many writers on the subject, have led to much waste of money on buildings too scattered for hospital service, which have turned out to be no healthier than the more compact and convenient structures which they superseded. But we ought not, in reaction from these exaggerations, to undervalue the importance of good ventilation, good aëration, proper isolation of beds, and, above all, scrupulous cleanliness, in hospital wards. These essentials being secured, the writer is persuaded that a hospital may be just as healthy with thirty wards as with three, with twenty patients in each ward as with two, and with five storeys as with one. Far more important, and far too little thought of, till within the last few years, is the amount of attention given to the personal care of the patients. This is particularly the case in the treatment of open wounds. Everyone who has been much in hospitals must have often seen, and especially abroad, surgeons, dressers, and nurses hurry from one patient to another, hardly washing or wiping their instruments, still less their hands, and using the same dressing materials for one case after another. Surgical practice cannot be safely carried on in this way, however healthy in itself the hospital may be. The first care of a surgeon in charge of hospital-wards ought to be to impress upon all his assistants, and never to forget in his own person, that the success of surgical practice depends more upon minute care in the dressing of cases, than on all other matters put together. Our surgical wards have become far more healthy since the introduction of antiseptic surgery;[1] and that this must be largely due to the increased care in the minutiæ of surgical treatment which has followed on the discussion of this method is proved by the fact that it is as conspicuous in some of those who reject as those who follow Mr. Lister's teaching.

If it were not true that the septic diseases, or erysipelatous diseases, which interfere so much with the success of operations in our hospitals, depend in a very large proportion of cases on the method of dressing the wound and not on matters conveyed by the atmosphere, how could the success of the so-called 'open method' of dressing wounds be explained? In this method the wound is left freely exposed to that hospital air which is, we are told, charged with deadly miasma. The size of the wards, number of beds, &c., are all of course unchanged; but care is taken to see that the wound is well drained of all putrefiable discharges, and kept perfectly clean. If Sir J. Simpson's theory were true, we ought to have an increased mortality following on the freer exposure to this deadly atmosphere. On the contrary, the perfect drainage of the wound, and the care taken to keep it free from all putrefying matters, are followed by results

[1] *On Hospitalism*, p. 98.

[2] The writer lays less stress on the total absence of any guarantee for the accuracy of Sir J. Simpson's table of cases in private practice, and is willing, for the sake of argument, to assume that the figures are correct.

[1] The late Mr. Callender stated it as his deliberate opinion that the great surgical operations are ten times more successful in hospitals now than they used to be in the past generation.

which can hardly be surpassed. Thus Dr. James Wood, of the Bellevue Hospital, New York, relates, that in wards which had been recently vacated on account of an outbreak of puerperal fever, he treated fourteen successive cases of unselected amputation of the limbs successfully, by merely leaving the flaps ununited, the raw surfaces exposed to the air, but carefully drained, and all putrescible matters continually removed;[1] and this is only one of many proofs which have recently been given of the fact that there are many other plans of treating wounds besides that which is specially designated 'antiseptic,' under which, conjoined with proper construction and general management, a hospital may be as healthy as a private house.

This statement, which is made after long experience, and with a conscientious conviction of its truth, by no means asserts that it is *as easy* to keep a hospital healthy as a private sick-room, or, in other words, that the aggregation of the sick and wounded involves no dangers. Such a doctrine would be absurd; but the dangers are the same in kind, and the precautions required are the same, with a single exception. Hospitals, like private houses, must be kept well-aired, well-drained, scrupulously clean, properly, but not excessively, lighted,[2] and so forth. The great difference in the precautions required to ensure the salubrity of hospitals and private houses is, in one word, to guard against direct infection, and this may occur in two ways. Surgically, infection is carried directly by careless dressing—and every hospital surgeon must have remarked that as he himself is more watchful and careful, and as he has the good fortune to be surrounded by more careful assistants, his cases do better; and in the present healthy condition of most of our large London Hospitals, such precautions of themselves suffice to raise the success of surgical practice to the same level as it reaches in private houses. The second way in which infection may be carried is by direct proximity or contact. This is more important in medical cases, and the obvious danger of the spread of infectious fevers has led the managers of most of our general hospitals to exclude such diseases from their wards as small-pox, scarlet fever, and typhus, while other affections are admitted, which, though contagious, are so in a less degree, as typhoid fever, erysipelas, diphtheria, &c. Enough, or more than enough, has been done in this direction—that is, the public safety might be as well consulted if typhus and scarlet fever cases were still admitted (as before the institution of special hospitals for such cases they used to be) into the wards of our general hospitals in small numbers, and under strict precautions. Anyhow, it appears that there is little if any evidence of spread of disease from such cases reputed to be infectious as are still to be found in our general hospitals. Hearing that some distinguished surgeons teach confidently that pyæmia and erysipelas are usually propagated by contagion, the writer has often watched the progress of such cases when originating in hospital or admitted from without, but has never been able to verify any spread of the disease from them, though he does not deny the possibility of such an occurrence.

To sum up the whole matter—the writer would define the term 'Hospitalism' as expressing the danger which exists in hospitals of contamination from the aggregation of patients — and would add that the extent to which such contamination prevails has been greatly exaggerated by theoretical writers; that, as far as the general atmosphere of the ward is concerned, the danger may be, and appears in all well-managed hospitals really to be, obviated by ventilation and cleanliness; and the more immediate danger from the contiguity of patients cannot be shown to produce any appreciable effect, while the danger of contamination of wounds by putrefying materials demands constant vigilance to counteract it; but with such vigilance seems to be so far counteracted that hospital practice is, for anything we know, as successful as private practice in similar cases. This is not an entirely satisfactory result, inasmuch as practice in a hospital, where every patient is under the strictest regimen and surveillance, ought to be much more successful than private practice, where the conditions are very different in these respects; but we are making rapid advances towards this desirable and perfectly attainable end. T. Holmes.

HOSPITALS, Administration of.—The administration of a hospital should be so framed as to enforce the necessary economy consistent with the due supply of the requirements for the sick.

Governing Body.—The administration is in the hands of a governing body, which usually consists of a committee or board, with an officer in direct communication with them, who acts as their representative. The governing body provides for the general supervision and discipline of the establishment, and for the financial arrangements. In this body is vested the appointment and removal of all members of the staff of the hospital. It makes all general regulations after consultation with the professional department, as to internal economy, admission and discharge of patients, distribution of beds, dietary and other matters. It takes steps for raising the funds to support the hospital, and regulates the expenditure.

Governor or Treasurer.—The active representative of the governing body is generally termed Governor or Treasurer. He exercises a general supervision over the structure and the discipline of the establishment. The chief executive officer immediately under the governing body is called the *Steward*, or sometimes the *Secretary*. He has the control of all servants not included in the nursing staff—such as porters, ambulance-men, engine-man, bath-assistants, and other male attendants. He sees that all structural appliances are in good order, and that cleanliness and discipline are maintained throughout the building. He controls the issue of all orders for the supply of goods, provisions, fuel, &c., and watches that they are used with a due regard to economy. He countersigns all orders for payment after they are passed by the treasurer,

[1] *New York Medical Journal*, Jan. 1876.

[2] Most of our hospitals are too light, and too destitute of the means of excluding the light. No doubt a flood of light in the ward is very useful in detecting dirt, but it sadly interferes with the repose which many medical and surgical cases require.

and is responsible for the hospital accounts. He sees that the records of admission, discharge, and death are duly kept by the professional staff. He is responsible for the safe custody of clothing, money, and property brought in by the patients, till their discharge. He has charge of the correspondence.

Clerk, or Assistant Steward.—The secretary or steward is assisted by an assistant or clerk. This latter receives all provisions and stores, sees that they are correctly delivered, and is responsible for their safe custody until distributed to an authorized person. He sees that the diet-tables are prepared from the prescription papers, and that the articles of food supplied to patients are strictly in accordance with the diet-table, or else specially ordered by the physician or surgeon.

Professional Staff.—The professional staff directs the proceedings to be taken for the well-being and cure of the patients. It consists of the consulting and visiting physicians and surgeons; the assistant physicians and surgeons; and the resident and house-physicians and surgeons, and assistants continually present in the hospital.

Medical Committee.—The professional staff forms a medical committee with a specified quorum. This committee is consultative only, and advises the governing body on all matters concerning the medical and surgical departments of the hospital, the admission and discharge of patients, the distribution of beds, the dispensary, the in-patients, out-patients' department, and the students. The medical committee, moreover, puts forward recommendations for the purchase of instruments, apparatus, and medicines. The committee provides for a descriptive record of cases admitted into the hospital; and for the efficient instruction of students.

Physicians and Surgeons.—The physicians, surgeons, assistant physicians and assistant surgeons undertake the charge of the wards and out-patients' departments, and attend at the hospital at fixed times. The physicians and surgeons order the diet of the patients, and no article of diet which does not appear in the diet-table is supplied unless specially ordered by them.

Resident Medical Officers.—The resident medical officers control the treatment of patients in the absence of the physicians and surgeons; and have a disciplinary control over the dressers and clinical clerks. They decide on the admissibility or otherwise of applicants for relief, when not admitted directly by the physicians and surgeons, as well as on the wards in which the in-patients are to be placed, and are responsible for their care until seen by the physicians and surgeons. They visit the wards and dispensary, according to the regulations, to see that the patients are duly attended to. They superintend the conduct of the assistants of the medical officers, and of the dispenser and his assistants, of pupils (if any), and of patients; give notice of any misconduct of the nurses and servants to the matron or lady superintendent; and inform the governor or secretary, the physician, surgeon, and governing body, of any matter requiring their attention. They are responsible that the records of cases are properly made out. In most cases, however, this duty is now performed by *registrars*.

Dispenser.—The dispenser acts under the resident medical officer, subject to regulations laid down by the governing body.

Nursing Department.—The nursing department is under a trained matron, who should be lady superintendent of the training school, and head of all the women employed in the hospital.

Matron or Lady Superintendent.—The whole responsibility for nursing, internal management, care of linen and housekeeping, and the discipline and training of nurses is vested in the trained female head of the nursing staff, by whatever title she be called. To the governing body of the hospital she is responsible for the conduct, discipline, and duties of her nurses. To the governing body and the physicians and surgeons in charge of wards she is responsible for the care and cleanliness of the wards, for the care and cleanliness of the sick, and for the linen. She is responsible to the medical officers that their orders about the treatment of the sick are strictly carried out. To fulfil these responsibilities, she has the power of engaging, appointing, and dismissing all nurses, female servants, and probationers, subject, of course, to the general control of the governing body. The nursing establishment cannot be made responsible on the side of discipline to the medical officers, or the governor of a hospital. Simplicity of rules, placing the nurses in all matters regarding management of sick absolutely under the orders of the medical staff, and in all disciplinary matters absolutely under the lady superintendent or matron, to whom the medical officers should refer all cases of neglect, is very important. Any remissness or neglect of duty is as much a breach of discipline as drunkenness or other bad conduct, and can only be dealt with to any good purpose by report to the matron. But neither the medical officer nor any other male head should ever have power to punish for disobedience. His duty should end with reporting the case to the female head, who is responsible to the governing authority of the hospital, as all her nurses and servants are, in the performance of their duties, immediately responsible to the matron only. If the matron or lady superintendent does not exercise the authority entrusted to her with judgment and discretion, it is then the legitimate province of the governing body to interfere and to remove her.

The matron resides in the hospital where her nurses and probationers are at work.

In a hospital of, say, above 300 beds, and with a training school of, say, above twenty probationers (which all such hospitals ought to include), the trained matron should have three trained representatives or assistants—one in the training school as mistress of probationers or home-sister; and two in the hospital,—one by day as assistant matron (or superintendent), and one by night as night superintendent of nurses; and of these two the night representative is the more important. Besides the trained assistant matron (superintendent) who should have such inspection of the wards as the matron may commit to her, the matron will

require one linen-assistant and housekeeper, who might also have the charge and inspection of the nurses' rooms, if the trained assistant matron has not time. She should 'mother' the ward-maids, and have some 'gathering' for them.

Nurses and Servants.—Under the matron there should be distinct grades of nurses, and distinct duties for each grade:—1. Trained chief nurses (ward sisters.) 2. Trained nurses (day). 3. Trained nurses (night), at least equal in pay and status to the day-nurses. 4. Probationers in training. 5. Ward-maids, and nursemaids for children's wards. 6. Dormitory and stairs women. 7. Female cook, and her assistants under the housekeeper. The hospital cook in a large hospital would probably be a man, and under the steward. The sisters, nurses, and probationers would require a female cook, under the matron. All women employed in the hospital should reside in the hospital.

Night Superintendent.—The (trained) night superintendent of nurses should be in charge of the night-nursing, in communication with the ward sisters, as well as of the night-nurses; should see that the ventilation and temperature of the wards is maintained—directed by the medical staff. She must be one qualified not only to have charge of nurses and have some 'gathering' for night-nurses by day, but to train probationers told off to accompany her at night, to their own benefit and hers.

Assistant Matron.—The assistant matron is to have special charge over the nurses' rooms, to see that the nurses rise in time to wash themselves, strip their beds, empty their slops, and have breakfast, before going on duty; that later they make their beds and put their rooms in order; that they never wash their own clothes in their own rooms, but all nurses' washing should be done for them; that they go quietly to bed at night, and lights be put out at a certain hour; that their rooms are always clean, in order, wholesome and cheerful. Without this constant supervision what is necessary for the nurses' health is not done; the same for night nurses is yet more important. Nurses' meals should always be presided over by some such authority.

The hospital night nurses should have two hot meals in the common dining room, it might be in the probationers' home, say at 9.30 a.m. and 9.30 p.m., ready and prepared for them. And sisters, staff nurses, and ward-maids should have, though at different hours—as all cannot be absent from the wards at once—dinner and supper, each set together in a common dining-room, away from the ward air. No nurse should have to prepare her meals for herself.

Laundry.—In small and moderate-sized hospitals, when there is a laundry attached to the hospital, the supervision should be under the lady superintendent or matron. In large hospitals, it would be advisable for the laundry, which should in all cases be in a building entirely detached, to be worked independently, under the general supervision of the governor or secretary.

Chaplain.—The religious care of the patients is generally provided for by the appointment of one or more permanent chaplains, or by visits and religious services of other ministers whom the patients may desire to attend them; subject, however, to the opinion of the medical attendant, as to how far the state of health of the patient will admit of such visits, and to the visits being made at such times as do not interfere with the discipline of the hospital.

DOUGLAS GALTON.

HOSPITALS, Construction of.[1]—A hospital or infirmary is a building intended for the reception and treatment of sick and injured persons, under conditions favourable for their recovery.

A hospital must be so constructed and arranged as to enable a limited staff of medical men, nurses, and assistants to minister to the necessities of a large number of sick, and to promote their speedy restoration. The conditions essential for such objects are as follows:—

(1) *Pure air.* There should be no appreciable difference in purity between the air inside the wards and that outside the building.

(2) The air supplied should be capable of being *warmed* to any required extent.

(3) *Pure water* should be supplied for internal use, and sufficient also to ensure the removal of impurities to a distance from the hospital.

(4) The most perfect *cleanliness* within and around the building should be enforced.

These conditions depend on—

(1) *The site of* the proposed hospital.

(2) *The form* of the rooms or wards in which the sick are to be placed, so as to ensure purity of air and convenience of nursing; these rooms forming the principal *units of hospital-construction.*

(3) The *distribution of these units*, and of the other accessories, which combined constitute the hospital.

1. Sites of Hospitals.—The local climate should be healthy, and there should be a free circulation of air over the district. Town sites should be avoided as far as possible. When necessarily placed in a town, a space free from buildings should be reserved on all sides. There should be no nuisances, damp ravines, muddy creeks, undrained or marshy ground, near the site, or in such a position that the prevailing winds would blow effluvia arising from them over the hospital. The site selected for a hospital should not receive the drainage of higher ground, and the natural drainage outlets should be sufficient. There should, if possible, be no buildings near a hospital except those connected with its object. The number of sick to be allowed per acre will depend practically upon the arrangement of the buildings in which they are lodged.

2. Form and Distribution of the Parts of a Hospital.—The structural arrangements of a hospital should be such as to secure free circulation of air.

THE WARD.—The basis upon which the structural arrangements rest is *the ward.* The administration, means of access, and discipline must be made subsidiary to the question as to

[1] This article has reference more especially to permanent general hospitals. The principles apply equally to special temporary field or other institutions for 'the cure of the sick.'

how the sick are to get well in the shortest possible time, and at the least expense; and this, so far as the structure is concerned, is mainly determined by the form of the wards.

Size.—The size of a ward depends upon the number of patients which it should contain, and upon the cubic space and floor space which should be allotted to each patient. The disciplinary and economical dispositions in a hospital require that each head nurse should have the patients allotted to her placed under her immediate eye. Economy of labour requires that the hospital should be so laid out as to enable the largest number of patients to be nursed by a given number of nurses. The *number* to be placed in a ward therefore depends upon the number which can be efficiently nursed; and the form of the ward must be as much calculated to facilitate nursing, as to ensure free circulation and change of air. From twenty to thirty-two beds have been taken as the unit for ward-construction. In hospitals where cases of more than ordinary severity are likely to be received, it would be necessary to diminish the size of the wards on grounds of health. Small wards containing one or more beds are also required for isolating certain cases or for various necessary objects.

Form of ward-construction. — The general form of ward-construction is mainly governed by the question of the renewal of air. The air within an inhabited space, enclosed on all sides, is vitiated by the emanations proceeding from the bodies of those who inhabit it, and especially by the effect on it of their respiration. In all sickness, and all surgical cases, wounds with discharge, or sores, these emanations are greater in quantity, and more poisonous in quality, than from persons in health; whilst, at the same time, most cases—medical and surgical—are more susceptible to these emanations. Stagnation in the movement of the air leads to rapid decomposition of these emanations. If they diffused themselves uniformly throughout the space, which in fact they do not, ventilation would be comparatively simple, and, whatever the cubic space, the air would attain a permanent degree of purity, or rather impurity, theoretically dependent upon the rate at which emanations are produced, and the rate at which fresh air is admitted. Hence the same supply of air would equally well ventilate any space; but the larger the cubic space, the longer it will be before the air in it attains its permanent condition of impurity, and the more easily will the supply of fresh air be brought in without altering the temperature, and causing injurious draughts. The amount of air which should be removed, and its place supplied with fresh air, is at least 3,000 cubic feet per patient per hour; but this must depend to some extent upon the emanations of the patients, which vary with the diseases or injuries they are suffering from. The ventilation of each ward should be kept independent of other wards or rooms.

Means of ventilation. — The change of air may be effected in various ways. For instance, the air may be drawn out by a fan; or it may be removed by a shaft, whose action depends on the difference of the temperature of the air in the shaft and that in the outer atmosphere. Of this the ordinary fireplace is one example; a caldron of water kept boiling for the use of the hospital by a steam pipe is another; a sunlight is a further example; and a heated shaft connected with flues led from holes in the wall near the patients' beds, through each of which air is drawn into the shaft, is another method. Theoretically it is thus quite possible so to arrange the ventilation mechanically that a specified quantity of air at a fixed temperature shall be brought into the ward by day and by night. Practically, however, hospitals dependent upon such means alone for ventilation, require an attention which they can rarely or never receive, and, except under favourable circumstances, are not healthy.

The emanations from the body do not uniformly diffuse themselves; they hang about as the smoke of tobacco may be said to do. In wards into which a fixed quantity of air is forced, there is not even a uniform degree of impurity; consequently it is necessary, in order to ensure the purity of the air of a ward, that means should exist for absolutely sweeping out at intervals all the impure air from it, and starting afresh with pure air. This is best effected by the direct action of currents of fresh air brought in by open windows placed on opposite sides of the wards. The distance between windows for this purpose must not be too great to prevent their efficient action in moving the air. Twenty-four feet is a good width, but opposite windows for such an object should in no case be more than from thirty to thirty-five feet apart. The space between the windows should not be obstructed by walls or partitions. The number of patients—that is to say, the sources of impure emanations—placed between opposite windows, should be limited to two rows. In the daytime, and when the weather admits of open windows, a ward with windows opening on both sides can easily be kept fresh; but for other seasons it is necessary to provide openings for the escape of impure air, and for the admission of fresh air which shall not cause draughts.

For the purpose of removal of air, shafts carried up from near the ceiling-level to above the roof are convenient, the lower ends being louvèred to prevent patients feeling down-draughts which may occasionally prevail. The most powerful engine of ventilation for drawing out the air is an open fire-place.

In order to prevent the temperature of the ward from being lowered by the extraction of air, that is, to maintain an equable temperature, and to prevent draughts, air warmed to a moderate degree should replace that removed by the fireplace or by other openings. Means for the admission of air in an upward current should be provided direct from the open air, independent of the windows and doors; for this purpose tubes with bends, which favour the collection of dirt, are objectionable. Sherringham's ventilators, which are easily cleaned, placed between the windows near the ceiling answer well; they admit the air without perceptible draught, and also frequently act as outlets when open on the leeward side of a ward. The external air may be warmed as it enters by being made to pass over hot-water

or steam tubes. Openings, if placed close to the floor under the beds, should be capable of being easily and securely closed. All openings for the admission of fresh air should be so placed as to be easily examined and cleaned throughout their whole length, and this should be done at least once a year.

Superficial area.—The next most important element in the question of ward-construction is the superficial area to be allotted to the patients, which is even more important than cubic space, for on this depends the distance of the sick from each other, the facility of moving round the sick, shifting beds, cleanliness, and other points of nursing. If there be a medical school attached to the hospital, the question of area has to be considered with reference to affording the largest amount of accommodation practicable for the teacher and his pupils without their breathing up the patients' air. A ward with windows improperly placed, so as not to give sufficient light, or where the beds are so placed that the nurse must necessarily obstruct the light in attending to her patients, will require a large floor-space, because the bed-space must be so arranged, and of such dimensions, as to allow of sufficient light falling on the beds. In well-constructed wards with opposite windows, the greatest economy of surface-area can be effected, because the area can be best allotted with reference both to light and to room for work. In a ward 24 feet in width, with a window for every bed or every two beds, a 7 ft. 6 in. bed-space along the walls would probably be sufficient for nursing purposes. This would give 90 square feet per bed, and there should be as little reduction as possible below this amount for average cases of sickness, but this space is much too small for surgical, fever-, or lying-in wards, which should also be for a much smaller number. The Herbert Hospital, without a medical school, has 99 superficial feet per bed; St. Thomas' Hospital, with a medical school, has 120 superficial feet per bed. The bed-space should be larger if the locality is less healthy.

The area allotted to patients practically settles the cubic space, because wards should not be less than 12 feet high, though as a rule they need not exceed 14 feet in height.

In a good situation, and for ordinary cases of disease, those spaces which are enough for nursing and for ward-administration would, with good ventilation, be sufficient for all sanitary purposes; but for such cases as typhus or other epidemic diseases, operations, and bad surgical diseases, a larger space and area would be required. When severe cases of this class come into an ordinary hospital, the simplest plan is to leave the bed vacant adjacent to that occupied by the patient.

Lying-in wards should never contain more than from one to four beds. In recent French hospitals these wards contain one bed each, and the only access to them is from an open verandah and through a small ante-room. Ovariotomy, and other operations of the highest risk, should be performed in a one-bed ward. When space permits, a room may be provided for the use of patients when convalescent, and able to be temporarily absent from the wards. The same observation applies to grounds for outdoor exercise. But separate convalescent hospitals or homes are better, both for health and discipline. If hospitals are provided for special infectious diseases, every patient should be placed in a separate hut-ward. Cleanliness and abundance of fresh air is the best safeguard against infection.

Materials.—With a view to economise heat in winter, and to keep the rooms cool in summer, the walls should be hollow, and all wards should be ceiled, unless the roof is constructed of a good non-conducting material. The best lining for a hospital-ward would be an impervious polished surface, which on being washed with soap and water, and dried, would be made quite clean. Plaster, wood, paint, and varnish all absorb the organic impurities given off by the body. Parian cement polished is the best material at present known for walls, but it is costly, and it can only be applied on brick or stone walls, and not on woodwork, because, being inelastic, it is liable to crack. Cracks in a hospital ward are inadmissible, as they get filled with impurities, and harbour insects. The numerous joints required for glazed bricks, or tiles, render the use of these questionable for wards. In default of Parian cement, the safest arrangement is plaster lime-whited or painted, which should be periodically scraped, and be then again lime-whited or painted.

The *floor* should be as non-absorbent as possible, and for the sake of warmth to the feet it must in this country be of wood. Oak, or other close hard wood, with close joints, oiled and beeswaxed, and rubbed to a polish, makes a very good floor, and absorbs little moisture. The joints should be like those of the best parqueterie, affording no inlet for dirt. There should be no sawdust, or other organic matter subject to decay, under the floor. When a ward is placed over another, it is essential that the floor should be non-conducting of sound, and that it should be so formed as to prevent emanations from patients in the lower ward passing into the upper wards. Practically, with care, a well-laid oak floor, with a good beeswaxed surface, can always be kept clean by rubbing.

There should be as little *woodwork* as possible in a ward, besides the floor; and what woodwork there is should be varnished, so as to admit of easy washing and drying. The cleanest and most durable material is varnished light-coloured wainscot oak or teak.

The form of the *windows* must be considered, in their aspect of affording light as a necessary means of promoting health, of affording ventilation, of facilitating nursing, and of enabling the patients to read in bed. Light can always be modified for individual patients. In order to give cheerfulness to the wards, and to renew the air easily, the windows should extend from within 2 feet or 2 feet 6 inches from the floor—so that the patients can see out—to within 1 foot from the ceiling. An end window to a long ward is an element of cheerfulness, and materially assists the renewal of the air at night. It is essential to cleanliness that every part of the ward should be light. One superficial foot of window-space to from 50 to 55 cubic feet of space, will afford a light and cheerful room, but

this depends much on aspect and upon the walls being light-coloured. To economise *heat* in wards, it is desirable to make the windows of plate glass; double windows of ordinary glass would secure the same object and facilitate ventilation, but they are troublesome to clean, and give a gloomy appearance to a room. The best form of sash for ventilation in this climate is the ordinary sash, opening at top and bottom; but windows made in three or four sections, each of which falls inwards from an axis at the bottom of the section, possess many advantages for hospitals.

Ward offices.—The Ward offices are of two kinds:—

1. Those which are necessary for facilitating the nursing and administration of the wards, as the head-nurse's room and ward-scullery.

2. Those which are required for the direct use of the sick, so as to prevent any unnecessary processes of the patients taking place in the ward; as, for instance, the ablution-room, the bath-room, the water-closets, urinals, and sinks for emptying slops. There should, in addition to the bath-room here mentioned, be a general bathing-establishment attached to every hospital, with hot, cold, vapour, sulphur, medicated, shower, and douche baths. Hot and cold water should be laid on to all ward-offices in which the use of either is required, because of the economy of labour in the working of the hospital. For the same reason, when the wards are on two or more floors, lifts should be provided to carry up coals, trays, and patients. The ward-offices should have ample window-space. There should be no dark corners or closed spaces under sinks. Nothing should be kept in these offices which is not in constant use, and everything in use should be open to inspection. All fittings should be light-coloured, so as to show dirt.

1. The *head-nurse* or *sister's room* should be sufficiently large to contain her bed, and to be also her sitting-room. It should be light, airy, and well-ventilated. It is necessary to discipline that it should be close to the ward door, and that it should when practicable have a window looking into the ward. If the head-nurse has two wards to supervise, her room should be placed between the two, with a window opening into each.

There should be a *ward-scullery* to each ward, and so situated as to be under the head-nurse's eye. The scullery should be supplied with efficient, simple apparatus for its purposes; there should be a small range for ward-cooking, so that the nurse can warm the drinks, prepare fomentations, &c. Shelves or racks should be provided. There should also be a small larder, with free circulation of air, for temporarily keeping provisions fresh. In the scullery, or adjacent to it, a hot closet should be provided for airing clean towels and sheets. Foul linen should not be retained near the wards, or in the hospital building. It should all be placed in baskets, on wheels, and conveyed as soon as possible to the laundry. Ward sweepings and refuse should similarly be placed in movable receptacles, and taken out of the building with as little delay as possible; structural provision for the retention of these in or near the hospital is undesirable.

2. The *ablution-room, water-closets, &c.*, ought to be as near as possible to the ward, but cut off from it by a lobby, with windows on each side, having its ventilation and warming distinct from that of the ward and that of the ward-offices, so as to prevent the possibility of foul air passing from the ward-offices into the wards. The ward-offices will be most conveniently placed at the end of the ward farthest from the entrance and nurse's room; and distributed at each side, so as to enable the ward to have an end window. In this arrangement the ablution-room would be on one side of the ward, and should contain a small bath-room with a fixed bath of copper, supplied with hot and cold water. A lavatory table of impervious material, such as slate or common marble, with a row of sunk porcelain basins with outlet tubes and plugs, each basin supplied with hot and cold water, should be placed in the same compartment as the bath, but separated from it by a partition and door. There should also be room for a portable bath for each ward; and there should be a sink on the floor level for running off the water from the bath after it has been used.

On the other side of the end window of the ward would be placed the *water-closets*. These should never be against the inner wall, but always against the outer wall of the compartment in which they are placed. A pan of a hemispherical shape, never of a conical shape, with a syphon, abundantly supplied with water to flush it out all round with a large forcible stream, is the best contrivance for the water-closet of a hospital. The urinal should be of a shape to be easily cleaned. The sink for slops, bed-pans, expectoration-cups, &c., which should have a compartment of its own adjoining the water-closets, should be a large, deep, round, pierced basin of earthenware, with a cock extending far enough over the sink for the stream of water to fall directly into the vessel to be cleaned, and with an ample supply of water in a full stream; this sink should be so arranged as to be flushed out like a water-closet pan, and it should be so placed as to make it unnecessary for male patients to pass the nurse on their way to the w.c. There should be a special receptacle near the sink, ventilated to the outer air, for keeping chamber utensils, &c., for the examination of the medical officer.

Walls of ablution-rooms and water-closets should be covered with white glazed tile, slate (enamelled or plain), or Parian cement; plaster is not a good covering for them on account of their liability to be splashed, and of the necessity for their being frequently washed down. There should be separate private water-closets for the nurses; and also water-closets for the patients when in day-rooms or recreation-grounds. The ablution-room and water-closets should be supplied with plenty of fresh air, warmed when necessary, and abundance of light, so as to ensure there being no dark corners. Three water-closets per ward will suffice for a ward of thirty-two beds, but two at least will be required for even a twelve-bed ward.

The water supply should provide, in addition to pure water for general consumption, a service

of distilled water for dressings and suchlike purposes.

3. **Aggregation of Ward-Units in the Construction of a Hospital.**—The principles upon which these units of hospital-construction, or, as they are generally termed, pavilions, when so constructed, should be aggregated, are as follows:—

(1) There should be free circulation of air between the pavilions.

(2) The space between them should be exposed to sunshine, and the sunshine should fall on the windows, for which purpose it is desirable that the pavilions should be placed on a north and south line.

(3) The distance between adjacent pavilions should not be less than twice the height of the pavilion reckoned from the floors of the ground-floor ward. This is the smallest width between pavilions which will prevent the lower wards from being gloomy in this climate; where there is not a free movement of air round the buildings, this distance should be increased.

(4) The arrangement of the pavilions should be such as to allow of convenient covered communication between the wards, without interfering with the light and ventilation, and therefore the top of the covered corridor uniting the ends of pavilions should not be carried above the ceiling of the ground-floor wards. Each block of wards, that is, each pavilion, should have its own staircase.

(5) No ward should be so placed as to form a passage-room to other wards.

(6) As a general rule, there should not be more than two floors of wards in a pavilion. If there are three floors or more, the distances between the pavilions become very considerable because of the rule already mentioned, which ought to be absolutely observed, which regulates the distance at which the pavilions must be kept apart. Besides, when two wards open into a common staircase, there is, with every care, to some extent a community of ventilation: this will prevail even if the staircase be furnished with permanent openings to the outer air. When there are as many as four wards one over the other, the staircase becomes a powerful shaft for drawing up to its upper part, and thence into the ward, the impure air of the lower wards. Similarly, heated impure air from the windows of the lower wards has occasionally a tendency to pass into the windows of the wards above. For the same reason the upper floor over the wards should not be used as a dormitory for nurses. Similarly if there is a basement under sick wards, it should not be used for any purpose, such as cooking, or for the reception of perishable stores, from which smells could penetrate into the wards; and it is best not to continue the staircase into the basement, for with every care the basement will always form a receptacle for ground air, which should be kept out of the hospital if possible.

There is a limit to the numbers which should be congregated under one roof. This limit will depend very much on the nature of the cases. In town hospitals, a double pavilion should not contain above 80 to 100 beds.

The size of any given hospital ought not to be determined by increasing the number of beds in any one building, but by increasing the number of units or wards. So far as the sick are concerned, they would be better placed in single detached wards; or, for convenience of administration, in wards all on one floor—opening out of a common corridor. But on town-sites the cost of land makes it absolutely essential to build hospitals as compactly as possible; moreover, economy in the current expenses will be best secured by a building with wards on two or more floors, provided with lifts and other labour-saving appliances.

In addition to the larger wards, it is necessary, as already stated, to have a few wards of one or two beds each for special cases.

Corridors should connect the pavilions on the level of the lower floor of wards only. They should be kept as low as possible, so as not to impede the circulation of air between the pavilions; they should be lighted by windows on both sides, opening widely, or removable in warm weather; and they should be provided with ample means of ventilation, and with fresh warmed air in cold weather, so as to prevent draughts.

The *staircases* should be treated similarly as to light and ventilation, and it is desirable to cut off the connecting corridors from adjacent staircases by swing-doors. These arrangements prevent draughts, and cause the passages and staircases effectually to cut off the ventilation of one pavilion from that of another.

The staircases for patients should be broad and easy; the rise of each step should not exceed four inches in height, and the tread should be at least one foot in width; there should be a handrail on each side, and a landing after every six or eight steps provided with seats. The patients in their beds may be wheeled on to the roof of the corridors between the pavilions, or on to a broad balcony outside the end window of the ward, in fine weather.

4. **Administrative Buildings.**—The necessary subsidiary accommodation may be briefly described.

Operating rooms, dispensary, and school.—These should include examining room, surgery, drug store, and operating theatre; the latter having roof-light from the north, and being of easy access to the surgical wards; there being one theatre for male, and one for female patients. Special wards for such cases as ovariotomy should contain but one bed. A dead-house and post-mortem room, with ample means of cleanliness, should be provided, quite outside, and detached from the hospital. Where a school is to be established, the necessary lecture-rooms, laboratories, dissecting-rooms, &c. should be kept entirely separate from the building for the sick.

All rooms should be plain, and without projections or ornaments, which form a resting-place for dust.

Officers' quarters.—Apartments for the resident physician and surgeon, matron, nurses, and servants should not, if practicable, be placed under the same roof with the sick. All the rooms should be light and airy. The resident physicians and surgeons should have each a bed-room and sitting-room, with proper convenience adjacent; and a dining-room for joint use.

The dispenser, if resident, requires a bed-room and sitting-room. An office is required for the steward (purveyor or financial officer); and a room for meetings of the governing body. Each ordinary nurse should have a separate bed-room; neither bare, tarnished, nor dismal; where she may obtain pure air while she sleeps—the night nurses' bed-rooms being apart, where they may not be disturbed by noise. There should be bath and closet accommodation near; but women should each be allowed a washstand and foot-bath in their own room. The head-nurse or 'sister' sleeps in her own room, overlooking her ward; but if there is no common-room, she would have better health if a small sitting-room, as well as bed-room, could be given her off her ward. The head-nurses or 'sisters should have a dining-room, and also a comfortable well-furnished sitting-room. They will work better in their wards if they themselves are made comfortable. For sisters and nurses now-a-days are, or ought to be, educated women. It is most undesirable that they should seek necessary amusement all out of doors. Nurses should dine in the sisters' dining-room, but at a different hour; and in a large hospital there would probably be required an additional dining-room for ward-assistants. In hospitals with an establishment for training nurses, which every large hospital ought to have, the probationers or pupil nurses (in a proportion not exceeding one to every ten or twelve patients) would live in a 'home' under the hospital roof, and under the direction of the hospital matron.

The 'Home' should consist of:—1. Class-room and nurses' library, large, airy, and convenient. 2. One or two dining-rooms, in which sisters and nurses might also dine, and pantry adjoining. 3. Two rooms and an office for the 'home sister' (class mistress). 4. One separate bed-room for each probationer, sufficient to contain press, table, chair, book-shelf, washstand, bedstead, and arm-chair.

Each floor should have a bath-room and other conveniences. Bed-rooms for probationers on night-duty should be cut off from the noise of the 'Home.' There should also be provided:—one sick room; one visitors' room; and servants' offices and bed-rooms for cook and other necessary servants.

Stores for bedding and linen, kitchen and provision stores.—The kitchen and all those stores between which and the wards there is a constant movement, should be as central as possible, so as to save labour; but the kitchen should be carefully cut off from the corridor connecting the pavilions. Attached to the kitchen should be a good scullery, larder, and serving conveniences. There should be a large, well-aired, well-lighted, well-warmed, well-arranged linenry and mending room. The hospital laundry should be detached from the hospital. Special care should be taken to make the laundry buildings airy and very light, with ample means of ventilation for removing the steam, which is heavily charged with organic impurity, and with ample space for the washers. They should have separate drying and ironing rooms.

Out-patients' department.— Those hospitals which afford out-door relief require a dispensary for out-door sick. This should always have an entrance separate from the hospital, and should never be under or near a ward, or in the space between adjacent wards. It is placed in proximity to the hospital, for the convenience of the medical men, and medical school (if any), and in order to be near the drug-store and apothecary's shop; but it should be entirely detached, with a free air-space between, and no direct communication be possible.

The out-patients' department requires a large airy waiting-room, with separation of sexes, and separate closet accommodation for males and females, which, without great care, may (even when detached) become a nuisance to the sick wards; a consulting room for each of the physicians and surgeons; to which should be attached a small lavatory and all necessary convenience for the complete examination of patients. The out-patients' department of Children's Hospitals requires more care, and more ample space in waiting-rooms, because each patient is brought by its nurse. The entrance and exit should be through different doors.

In every large hospital should be provided a well-ventilated chapel, capable of being well warmed.

The position and general construction of the administrative buildings should be made quite subservient to the accommodation for the sick, and to the broad general principle that these buildings should not interfere with the circulation of the air round, or the light of, the wards.

DOUGLAS GALTON.

HUM, VENOUS.—A continuous murmur heard in the veins, generally observed in cases of anæmia. *See* ANÆMIA; and PHYSICAL EXAMINATION.

HUMID (*humidus*, moist).—Moist—in contradistinction to *dry*. Applied to râles (*see* PHYSICAL EXAMINATION); to characterise a variety of asthma attended with expectoration (*see* ASTHMA); and also to particular climates. *See* CLIMATE.

HUMORAL (*humor*, a humour).—Of or relating to the humours. Chiefly used as a term for a pathological doctrine—the *humoral pathology*—which associates all diseases with morbid states of the fluids of the body (*see* BLOOD-DISEASE). The word is also sometimes employed as synonymous with *humid*, when applied to asthma.

HUNYADI JÀNOS, in Hungary. Sulphated waters. *See* MINERAL WATERS.

HYDATIDS (ὑδατὶς, a drop of water).—SYNON.: Fr. *Hydatide*; Ger. *Blasenwurm*.

GENERAL REMARKS.—This term is now restricted to those bladder-worms which are larval forms of the so-called *Tænia echinococcus*—a minute tapeworm residing in the dog and wolf. Formerly all the bladder-worms were apt to be spoken of as hydatids, and thus we had the *Hydatis cellulosæ*, *H. erratica*, *Hydatigena granulosa*, and so forth. They were also frequently called *acephalocysts*, and thus, following Laennec, we had the *Acephalocystis granulosa*, *A. exogena* and *endogena* of Kuhl and John Hunter, *A. surculi-*

yera, &c. Again, they were as often characterised as various species of *Echinococcus*, whence we had the *Echinococcus hominis*, *E. veterinorum*, *E. polymorphus*, *E. granulosus*, and so on. At length, all these numerous forms of hydatid were reduced to a very few types, and now we are all agreed that there is only one true larval species, although it is liable to assume a practically endless variety of shapes.

That the minute tapeworm (*Tænia echinococcus*) is really the sexually mature condition of the ordinary hydatid, as known to physicians and surgeons, was first experimentally proved by Naunyn, who, in 1864, fed two dogs with liver hydatids, previously ascertained to contain heads (*scolices*). The first dog, destroyed twenty-eight days afterwards, yielded a negative result; but the second dog, killed thirty-five days subsequent to the feeding, contained numerous examples of *Tænia echinococcus* in the sexually mature condition.

By feeding dogs with fresh and perfectly formed hydatids we have thus obtained the minute tapeworm which selects for its abode the upper part of the small intestine. Conversely, hydatids may be reared by feeding animals with the eggs of the *Tænia echinococcus*. It appears that the formation of all true hydatids, whether developed in mankind or in animals, results from the ingestion of the tape-worm eggs. The eggs may be swallowed either with food or drink. In this way, impure water is doubtless the most common source of hydatid disease. All open waters, if dogs abound in the neighbourhood, are liable to be contaminated with the fatal germs. The careless drinking of unfiltered or insufficiently filtered water may lead to hydatid infection.

The formation of hydatids, after the eggs have been swallowed, is a very slow process. What we know on this point is principally due to the researches of Leuckart; but our knowledge of the intimate structure of the perfected organism, as such, has been very carefully worked out by a number of observers, amongst whom, after Leuckart, stand the names of Rasmussen, Naunyn, Heller, Von Siebold, Eschricht, Wagener, Küchenmeister, Erasmus Wilson, Busk, and Huxley. In this connection also, particular mention must be made of the researches of Virchow, who was the first to make us acquainted with the true nature of the multilocular form (*Echinococcus multilocularis*) which has also been investigated, amongst others, by Luschka, Leuckart, and Heller. In the more purely pathological and statistical aspects of the subject, the writings of Rokitansky, Schleisner, Wunderlich, De Haen, Krabbe, Klencke, Livois, and Davaine hold a conspicuous place; whilst clinically we have space only to particularise the memoirs of Murchison, Begbie, Cleghorn, Macgillivray, Robertson, Dougan Bird, and especially Hearn (*Kystes Hydatiques du Poumon*; Paris, 1875). From the above statement, it will readily be understood that the literature of the subject is of very great extent; but those who desire an exhaustive knowledge of the subject should also consult Dr. Albert Neisser's admirable compilation (*Die Echinococcenkrankheit*: Berlin, 1877). In this place it is only intended to offer a brief account of the general structure of hydatids, with a *résumé* of the facts of their distribution and prevalence in particular countries, and their occurrence in the organs of the body selected for residence. Remarks on treatment, and on the hygienic bearings of the subject will fitly close the article.

Description. — Pathologists recognise three varieties of hydatid, namely, the exogenous, endogenous, and multilocular. The first of these is sparingly found in man, but very common in the lower animals. The second is rare in animals, but frequent in the human subject. The third variety is found in man, very rarely; Professor Bollinger having also found it in the liver of a calf (*Deutsch. Zeitsch. f. Thiermed.*; 1876). The precise mode of origination and growth cannot be discussed here. Practically, it is of little moment which of the various hypotheses we accept; nevertheless the subject is of the highest interest when viewed from a physiological standpoint. Whilst there is rarely any difficulty in determining the character of ordinary hydatids, whether of the exogenous or endogenous kind, the multilocular form is very apt to be overlooked or misinterpreted. It has been mistaken for alveolar colloid, with which latter product, as remarked by Virchow, it has nothing whatever in common. There is reason to believe that some of the so-called examples of cirrhosis of the liver are neither more nor less than multilocular hydatid growths. Professor Heller, of Kiel, has called our attention to several preparations in the London Museums, which he thinks may be of this order, but the writer has not found opportunity to examine them microscopically. Condensing Leuckart's description, which we have ourselves verified from the examination of a specimen kindly supplied by Heller, it may be said that the essential characters of this growth are marked by a tough, well-defined fibrous limiting capsule, consisting of a dense stroma, whence bands of connective tissue pass off in every direction, penetrating the entire growth, and leaving small interstices. These interstices or alveoli are irregular in shape, lined with vesicles that are filled with a gelatiniform plasma, occasionally containing also the so-called echinococcus-heads. Here and there small blood-vessels may be seen, and also collapsed bile-ducts, but no trace of any true glandular parenchyma of the organ affected.

Ordinary hydatids, whilst presenting variable shapes according to the nature of the organ occupied, commonly exhibit a thick investing capsule derived from the tissues of the infested part. Within this capsule or cyst we first come upon a thick, homogeneous, laminated, elastic membrane, which, if withdrawn, displays a peculiar tremulous motion, coiling upon itself wherever it happens to be divided by the scalpel. This is the so-called cuticular, structureless layer, or *ectocyst* of Huxley. Within this outer layer, and closely applied to it, lies the delicate *endocyst* of the same authority. This is a thin, soft, comparatively non-elastic, granulated membrane, forming the essentially vital part of the bladder-worm. From this inner membrane buds are produced, and these gemmæ become transformed into echinococcus-heads both in a direct and

indirect manner. Commonly they form broad capsules containing numerous heads, some of which, by a process of eversion, may be seen

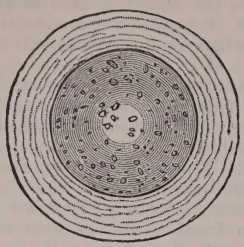

FIG. 24. Hydatid of four weeks' growth, showing ectocyst and endocyst. × 60. After Leuckart.

projecting into the general cavity of the mother-hydatid. At other times by a process of what is termed proliferation, daughter and even grand-daughter hydatids are formed within the

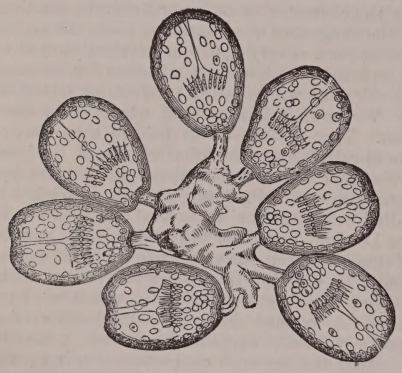

FIG. 25. Group of Echinococci, with their hook-crowns inverted. × 180 diam. After Busk.

original maternal hydatid, and these smaller hydatids (constituting an agamogenetic bladder-worm progeny) in their turn produce echinococcus-heads within them. The precise mode of origination of these buds is still a subject of dispute, notwithstanding the remarkable investigations of Leuckart, Naunyn, and Rasmussen. Neither of the two former authorities believes that the *heads* can be formed in a direct manner from the endocyst, as described and figured by Huxley. The question as to the existence of cilia on the endocysts and brood-capsules is also unsettled. Cilia have been noticed by Owen, Lebert, and Whittell. These various authorities aver that they occur outside the so-called echinococci. Huxley looks upon them as having a connection only with the water-vascular system, whilst Leuckart entirely failed to detect them anywhere. We are not here called upon to pursue this part of the subject further, but may remark in passing that the little sacs now termed brood-capsules by Leuckart and others were well known to Erasmus Wilson, who figured them in 1845, and also to Busk, who previously spoke of them as 'granulations' (1844).

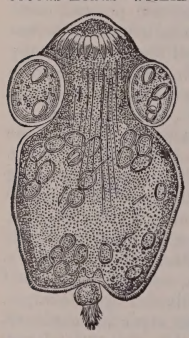

FIG. 26. The so-called *Echinococcus head*, showing hooks, suckers, cilia, and corpuscles. × 250 diam. After Huxley.

OCCURRENCE.—The prevalence of hydatids in any country bears a strict relation to the degree of intimacy subsisting between its inhabitants and the dogs employed by them for domestic purposes. If in this respect Iceland holds pre-eminence; the explanation is not far to seek. As remarked by Krabbe, it is not necessary to suppose that the Icelanders actually devour the excrement of dogs, although, to be sure, canine fæces, according to Schleisner, figure amongst the remedial agents employed by quacks and empirics. It is sufficient for the purpose of infection that the natives and their dogs share the same habitation, that the animals are fondly caressed, that they feed off the same plates (which they are often encouraged to lick clean, in order that their masters may be spared the trouble of having them washed), and that they sleep with the peasants in the same bed. Thus, as Krabbe says, either through carelessness, ignorance, or indifference on the part of the natives, the eggs of the hydatid-forming tapeworm have abundant opportunity of gaining access to the human bearer. To a certain extent, as Krabbe observes, this close relationship and high degree of infection are forced upon the poor people by the rigours of the climate, and insufficient resources of the country. Nevertheless, it is clear that a very large amount of echinococcus-disease exists in countries where there is comparative freedom from these disadvantages. The circumstance that the germs are far too small to be seen by the naked eye, and that they may be distributed by various possible agencies (long after they have either been passed with the fæces, or have been dispersed by the semi-independent and sexually ripe proglottides), is alone sufficient to ensure infection, provided the necessary sanitary precautions are not adopted. Open natural waters, however pure and sparkling they may look, are apt to contain hydatid germs in all countries where dogs abound. Thus it is that cattle become infected; not alone indeed by drinking foul water, but also by grazing in districts where the eggs of the *Tænia echinococcus* are dispersed by winds, rain, and even insects flying away from the germ-infected fæcal matter on which they had previously settled for repast. Of course, direct contact with infested dogs renders infection almost a matter of certainty. Anyone who has witnessed the migration of tapeworm proglottides on the surface of the bodies of cats and dogs, will readily understand how it comes to pass that the mere act of coaxing a dog's back is sufficient to convey numerous germs to the hand, whence they may be transferred to the lips and mouth of the human bearer. It is fortunate, indeed, that in European countries our *Tænia echinococcus* is comparatively rare in the dog. But for this circumstance, hydatids might become almost as prevalent amongst the peasantry of our own country as they are known to be in Iceland. Probably the next most infested territory is that of Victoria (Australia). On this

point the writer has collected much convincing evidence; recently confirmed by Dr. David Thomas, of Adelaide. According to one local authority, not only has the disease been more or less prevalent in the Victoria colony for many years past, but it is 'greatly on the increase in the human subject.' It would be easy to multiply statements bearing out the same truth, but the subject is too special for detailed treatment, and it has been dealt with, at some length, in the writer's general treatise (*Parasites*; London, 1879). Those, also, who desire to obtain a general notion of the frequency of hydatids in England would do well to reflect upon the amount of collateral evidence supplied by the numerous specimens preserved in the museums of the metropolis and elsewhere. In the face of facts, patent to all, it must be obvious that the amount of hydatid disease now existing everywhere, is susceptible of being greatly diminished by the introduction of appropriate sanitary regulations. In what these regulations consist may be readily gathered from the circumstances connected with infection. To some extent, Iceland has already moved in the matter, following the counsel of Dr. Krabbe.

Situations.—The relative prevalence of hydatids in particular organs of the body is a matter of great concern, clinically and hygienically. The writer has been at some pains to open up this subject, and from the data collected independently by Davaine and himself, the results obtained may be relied on as approximately correct. Reduced to the lowest number of practically available or useful terms, our statistics stand as follows:—

Organs affected.	Davaine.	The writer.	Total.
Liver	165	161	326
Abdomen, pelvic cavity, and spleen	26	45	71
Lungs	40	22	62
Kidneys and bladder	30	23	53
Brain	20	22	42
Bones	17	16	31
Heart, and pulmonary vessels	12	13	25
Miscellaneous	63	25	92
Grand total	373	327	700

Notwithstanding certain apparent differences, the results separately obtained by Davaine and the writer show a remarkable correspondence. Thus, in the case of those organs respecting which no dispute could well arise as to the real seat of the disorder, the results are tolerably uniform. This is seen in the case of the liver, brain, heart, and bones. Even in those instances where the results do not appear to correspond, the explanation of the discrepancies is very simple. One example will suffice to illustrate this point. The twenty-six abdominal cases credited to Davaine's record are all placed by him under the heading of 'Pelvis,' whilst all those cases placed by the writer under the abdominal series not only include hydatids of the pelvic cavity, but also two from the spleen and nineteen from the peritoneum and intestines, besides others.

As the facts thus stand, it is instructive to notice that the liver cases comprise nearly 46½ per cent. Comparatively recent computations by Dr. Albert Neisser, based on 983 cases, afford a percentage of 45·765 for liver cases. It is especially worthy of remark also that no inconsiderable proportion of the bladder-worms occupy organs of vital importance to the host. If, in reference to sanitation, statisticians would obtain an adequate conception of the cause of the fatal power of hydatids, they should look close into this matter. Let them note the fact that in 6 per cent. of all the cases collected by Davaine and the writer the entozoon occupied the brain; in about 3½ per cent. they took up their residence in the heart; and probably in not less than 15 per cent. of all the other cases they operated to bring about the death of the human bearer. The writer is of opinion that (excluding the cases cured by surgical interference) the echinoccocus-bladderworm proves fatal to 25 per cent. of all the human victims it attacks. Animal-bearers, on the other hand, comparatively rarely succumb to hydatid invasion. (For further details see *Lancet*, Jan. 19, 1875, p. 850; *British Medical Journal*, 1875; and the writer's treatise on *Parasites*, 1879, pp. 121–141.)

Diagnosis.—Many cases of hydatids present extreme difficulty in respect of diagnosis, especially those occupying the cavity of the chest. To diagnose hydatids of the brain, heart, and kidneys is rarely possible, unless very strict attention be paid to the symptoms, and to the conditions under which the patient has been living. In kidney cases, the escape of small vesicles with the urine, would, of course, help to decide the matter. In heart-cases it is rare that any premonitory symptom of the affection shows itself. Under ordinary circumstances, where these and certain other organs are out of the question, the presence of a fluctuating tumour, without any concomitant inflammatory symptoms, especially if it be seated in the region of the liver, would to most of us at once suggest the likelihood of the occurrence of an hydatid growth. Much has been said of Piorri's 'hydatid fremitus,' which, however, scarcely differs from the ordinary impulse communicated by fluid matter within any other kind of tumour. Speaking generally, the accidental discharge of one or more acephalocysts constitutes the most common and absolutely certain means of diagnosis. That these formations are frequently discharged by the natural outlets of the body is well known to every practitioner; and not unfrequently has the scalpel of the surgeon evacuated them, when their presence was not so much as suspected by the operator. How constantly their presence within the viscera is altogether overlooked is a matter well known to every pathologist connected with our large hospitals.

Treatment.—The treatment of hydatid-disease may naturally be spoken of under three heads, namely, *surgical*, *medical*, and *prophylactic* or preventive.

Surgical.—With the first method we have of course little to do here, but in respect of diagnosis it is obvious that the surgeon must often require the assistance of the physician. In the matter of operative treatment, the writer has elsewhere taken occasion to comment, incidentally, upon the remarkable amount of success obtained by Dr. MacGillivray, at the Bendigo

Hospital. (See his records given from time to time in the *Australian Medical Journal.*)

Medical.—As regards the success of medical treatment, the opinion long ago expressed in the writer's Introductory treatise still holds good (*Entozoa,* 1864, p. 285). As then stated, 'a great deal of nonsense has been written about the efficacy of particular drugs,' but, making allowance for the advantages secured by aspiration and electrolysis, we think that the words spoken by Dr. Todd in 1851, are still very near the truth:—'I know of no cure for hydatids but the evacuation of them. There is a popular notion that salt will kill the hydatid. Iodide of potassium has also been frequently tried, but I have never seen any real benefit from the use of these remedies.' Since Dr. Todd's time, the employment of several other drugs has been warmly advocated by different physicians, amongst whom the names of Dr. Leared, Dr. Hjaltelin, and Dr. Bird stand out most prominently. According to the two first-named observers *kamala* has the power of destroying hydatids. If, however, anyone will take the trouble to peruse Dr. MacGillivray's record of his efforts to obtain proof of the alleged curative properties of kamala, when administered internally, they will at once perceive that this much over-praised drug has 'no influence whatever on the disease.' In like manner, the writer fears that the alleged virtues of turpentine in this respect, as advocated by Australian practitioners, will turn out to be an entire mistake. It is all very well to speak of turpentine and certain other well-known anthelmintics as powerful tæniafuges; but it is quite another thing to assert that these drugs can destroy bladder-worms by the ordinary mode of oral administration. As stated in the early part of this article, the essentially vital part of the hydatid is the granular endocyst, and to reach this the poison must not only penetrate the more or less dense capsule of connective tissue, but also the laminated ectocyst. If the advocates of kamala had reflected on the enormous quantity of the drug necessary to produce any sensible effect on the hydatid, they would probably not have attempted its employment. In like manner, notwithstanding what has been said of the power of turpentine, in respect especially 'of its property of accumulating in the system,' we must express ourselves as exceedingly sceptical as to the likelihood of turpentine being of any more curative value than kamala when prescribed internally. In regard to the successful employment of iodine and other drugs for the purposes of injection, after evacuation of the fluid contents of hydatid cysts, there can be no doubt as to the good results frequently obtained; nevertheless, as M. Boinet and others long ago pointed out, certain precautions are necessary, especially when dealing with growths occupying the neighbourhood of serous cavities. In this connection Davaine's *Traité des Entozoaires* should be consulted, and also Hearn's clinical work, which, so far as hydatids of the thoracic cavity are concerned, is thoroughly exhaustive and reliable. We are entirely in accord with Hearn, who affords us a true criterion of his estimate as to the value of drugs when he incidentally remarks that the medical treatment of hydatids in no way affects the prognosis.

Prophylactic.—The prophylactic treatment of hydatids deserves the most serious attention of those interested in the advance of State medicine. As all the circumstances favourable to the production of the echinococcus disorder are now well known, it clearly follows that the malady falls within the category of those endemics which admit of being either largely checked, or altogether stamped out. There is no need to recapitulate the ætiology of the subject at any length, and the writer can only again insist upon the adoption of those measures which he has sought to enforce for many years past. He has recommended that boiling hot water should be thrown over the fæces of dogs, not only in kennels, but in all places where the excreta are exposed. To attempt to collect and burn the fæces would be too troublesome a process, and not so effective, since a large number of the invisible eggs scattered on the ground or flooring would inevitably escape. In this view, the late Dr. Leared's proposal that every dog should be efficiently purged with an anthelmintic and cathartic at certain intervals is worthy of attention. Dr. Leared further advised that the excreta should be buried; but the writer's plan of destruction of the germs by boiling water seems more effective and more easy of accomplishment. Professor Leuckart, in an elaborate but popularly written article, embodying a review of all the more important facts of helminthological study in relation to the public health (*Unsere Zeit,* 1862, s. 654), gives an admirable summary of the sanitary bearings of the subject in the following terms:—'In order to escape the dangers of infection, the dog must be watched, not only within the house, but whilst he is outside. He must not be allowed to visit either slaughter-houses or knackeries, and care must be taken that neither the offals nor hydatids found in such places are accessible to him. In this matter the sanitary inspector has many important duties to perform. The carelessness with which these offals have hitherto been disposed of, or even purposely given to the dog, must no longer be permitted, if the welfare of the digestive organs of mankind is to be considered. What good results may follow from the adoption of these precautions may be readily gathered from the consideration of the fact that, at present, almost the sixth part of all the inhabitants annually dying in Iceland fall victims to the echinococcus epidemic.' The Leipzig helminthologist next dwells upon the conditions already shown to be so eminently favourable to the production of the disorder, and concludes by remarking that 'cleanliness is one of the most important preservatives against infection.' Without doubt this is so; but, as a matter of fact, no amount of care in this respect will ensure immunity from hydatid disease. Occasionally, though happily very rarely, the most delicately nurtured persons, who have all their lifetime lived, as it were, in the lap of luxury, fall victims to the malady. One such case, that of a lady, was not very long ago brought under the writer's notice by an eminent practitioner, who tapped the abdominal tumour, at first suc-

cessfully, but on a second occasion with a fatal result to the patient. The explanation of the occasional occurrence of hydatids in high life is not far to seek. The act of drinking a glass of water from some doubtfully good or unfiltered source, or, still more probably, the partaking of salad (derived from some market-garden source, and not properly cleansed before being sent to table), is quite sufficient to account for infection. A single invisible germ or echinococcus-ovum thus transferred to the stomach of the human host, is capable, after a lengthened interval, say of a year, of presenting itself as an hepatic tumour of considerable dimensions. What obtains thus infrequently amongst well-to-do persons in life, must necessarily happen more commonly to those whose occupations naturally bring them more directly in contact with the ordinary sources of infection. In a paper, 'On the comparative prevalence of different forms of entozoa infesting the dog' (*Linn. Soc. Journ.*, 1867) the writer has called attention to the desirability of instituting special investigations in reference to the frequency of the occurrence of the hydatid tapeworm in the dog in England. By adopting, both at home and in our colonies, the admirable mode of procedure initiated by Krabbe in Iceland and Denmark, a large amount of valuable information, available for sanitary guidance, could not fail to be obtained. Hundreds of dogs are annually destroyed in this country, yet no public officer, possessing a practical knowledge of the subject, has ever examined their carcases with the view of ascertaining the prevalence or otherwise of parasites within them. The amount of good which has already been accomplished by private efforts (not unattended with personal sacrifices) in this direction is by no means inconsiderable. These efforts have led to the discovery of the causes of several destructive epidemics. In respect of the sexually mature echinococcus tapeworm, Dr. Krabbe has shown that no less than 28 per cent. of Icelandic dogs are infested. His investigations have thus furnished us with a striking result, which, to the thoughtful and cultured sanitarian, readily explains the extraordinary prevalence of hydatids in that country. *See* Acephalocysts; Bladder-worms; and Echinococcus. T. S. Cobbold.

HYDATIDS, UTERINE. *See* Mole.

HYDRÆMIA (*ὕδωρ*, water, and *αἷμα*, the blood).—A watery condition of the blood. *See* Anæmia; and Blood, Morbid Conditions of.

HYDRAGOGUES (*ὕδωρ*, water, and *ἀγω*, I drive).—Synon.: Fr. *Hydragogues*; Ger. *Wassertreibende Mittel.*

Definition.—Purgative medicines which cause a copious watery discharge.

Enumeration.— Hydragogue purgatives include:—Bitartrate of Potash, Buckthorn, Colchicum, Colocynth, Croton Oil, Elaterium, Gamboge, Hellebore, Jalap, Podophyllin, and Scammony.

Action.—It has been supposed by some writers that the action of the drugs included in the present class is due only to the increased peristaltic action which they produce. This, however, is not the case, as certainly some, if not all, of those just enumerated, induce a free secretion of fluid by the intestinal mucous membrane, while at the same time they stimulate the peristaltic action of the bowel, and cause the evacuation of this watery fluid.

Uses.—Hydragogues are chiefly employed for the removal of fluid from the body, in cases either of general anasarca or of dropsical effusion in serous cavities. They may be employed to assist the action of the kidneys when this is insufficient; and it has been observed not unfrequently, when the secretion of urine has previously been deficient, that it becomes greatly increased after a free discharge of fluid has taken place from the bowels, in consequence of the administration of a hydragogue cathartic. *See* Purgatives. T. Lauder Brunton.

HYDRARGYRIASIS (*hydrargyrum*, mercury).—The state produced by the introduction of mercury into the system. *See* Mercury, Poisoning by.

HYDRARTHROSIS (*ὕδωρ*, water, and *ἄρθρον*, a joint).—Effusion of a serous fluid into a joint. *See* Joints, Diseases of.

HYDROA (*ὕδωρ*, water).—A term used by Hippocrates, and expressive of a sweat-eruption. By the Latins the condition was named *sudamina*, and in modern times it is called *miliaria.* The term hydroa has also, with doubtful propriety, been applied to the larger vesicle of herpes; and more recently to herpes, or rather, pemphigus iris. Erasmus Wilson.

HYDROADENITIS (*ὕδωρ*, water, and *ἀδήν*, a gland).—Description.—This affection was first described by Verneuil and Bazin as a minute phlegmon of the sweat-gland, resulting in a flat pustule, and met with chiefly in those situations where the sudatory glands are most largely developed, for example, in the axilla, on the areola of the nipple, and at the verge of the anus. Hydroadenitis occurs singly or in crops. It first becomes developed into a small tubercle; and, when pus forms, it breaks upon the surface, and the tubercle subsides. The disease has been attributed to irritation from friction, discharges, or absence of cleanliness; and is said to be favoured by an unhealthy constitution.

Treatment.—After the more obvious indications of improvement of the general health and removal of local irritants have been attended to, it has been recommended to paint the affected part with the liniment of iodine. Erasmus Wilson.

HYDROCARDIA (*ὕδωρ*, water, and *καρδία*, the heart).—An effusion of serous fluid into the pericardial sac. *See* Pericardium, Diseases of.

HYDROCELE (*ὕδωρ*, water, and *κήλη*, a tumour).—Synon.: Fr. *Hydrocèle*; Ger. *Wasserbruch.*

Definition.—A swelling produced by a collection of fluid in connection with the testicle or spermatic cord.

Description.—The principal forms of hydrocele of the testicle are the *vaginal*, the *congenital*, and the *encysted.*

Vaginal Hydrocele.—Description.—This is a chronic dropsical effusion into the sac of the tunica vaginalis. The fluid is a pale-yellowish serum, which in old cases is often loaded with cho-

lesterine. The quantity varies, but seldom exceeds twenty ounces. The writer has removed as many as forty-eight ounces. The testicle is usually situated at the back part and rather below the centre of the sac; but its position may be altered by adhesions; and, in cases of congenital inversion, the testicle is in front of the sac. In old hydroceles the sac is often greatly thickened by deposition of lymph on the tunica vaginalis, and its conversion into fibrous tissue, which is sometimes the seat of calcareous deposits. It is generally single, but often occurs on both sides. Vaginal hydrocele forms an oval or pyriform swelling, which fluctuates; has a smooth, even surface; and commences at the lower part of the scrotum, very gradually and without pain. When examined by transmitted light it is found to be translucent, except at the back part, where the testicle is situated. Owing to the tunica vaginalis remaining unobliterated for some distance along the cord, the swelling occasionally assumes an elongated form, and extends up towards the inguinal canal. A hydrocele sometimes varies in size, becoming larger and more tense during the day than when the patient first rises in the morning.

Ætiology.—Hydrocele is a common disease, especially in warm climates; and occurs at all periods of life, but is most common in middle age.

Diagnosis.— The circumstances — that the swelling commences below; that the spermatic cord can be detected above the tumour; that the testicle cannot be felt; and that the tumour receives no impulse on coughing, and does not vary in size on pressure—are signs distinguishing a hydrocele from an inguinal rupture. When the sac is much thickened, so as to obscure fluctuation, and prevent the passage of rays of light, the tumour may be mistaken for a hæmatocele, or disease of the testicle, and the diagnosis is difficult.

Treatment.—In *infants*, vaginal hydrocele usually disappears under the application of weak tincture of iodine. Acupuncture, causing the fluid to escape into the areolar tissue of the scrotum, is the only operation that is required.

In the *adult* external remedies are of no use. It is usual to resort at once to operative treatment, *palliative* or *radical*. The *palliative* operation consists in puncturing the tumour with a trochar, and evacuating the fluid accumulated in the tunica vaginalis. The hydrocele usually returns in the course of two or three months, and then the operation must be repeated, or the patient must undergo *radical* treatment. This may be effected by incision or excision of the sac; by the passage of a seton; or by injection of the sac with a stimulating fluid. The latter is the plan commonly resorted to; and the fluid almost invariably employed is the tincture of iodine. The only apparatus required, in addition to a medium-sized trochar, is a glass syringe. The writer generally injects about a drachm of strong tincture, which he leaves in the sac. It causes considerable pain, extending to the loins; but all suffering may be prevented by ether or chloroform inhalation. The iodine acts as a stimulant, stirring up mild inflammation, and causing a rapid return of swelling, which gradually subsides until the patient is cured. Compression with strapping helps the absorption. In double hydrocele, injection may be performed on both sides at the same time. Injection rarely fails to cure the hydrocele. If it does not succeed, recourse can be had to the seton; or, in cases of thickened sac, to incision or excision.

Congenital Hydrocele.—In children, the original communication between the cavities of the peritoneum and of the tunica vaginalis sometimes fails to be obliterated; and fluid accumulated in the sac constitutes the variety termed congenital hydrocele. The communication is usually small in size.

Diagnosis. — Congenital hydrocele is easily distinguished from ordinary hydrocele by the absence of a defined boundary on the upper part of the tumour; by the impulse received on coughing; and by pressure causing the disappearance of the swelling, and rendering the testicle perceptible. It is distinguished from a reducible hernia by the fluctuation and transparency of the swelling; by the absence of gurgling accompanying its disappearance on pressure; and by the slow return of the swelling on the patient assuming the erect posture.

Treatment.—Congenital hydrocele is readily cured by the gentle pressure of a truss on the inguinal canal, so as to occasion obliteration of the neck of the sac, after which the fluid usually becomes absorbed.

Encysted Hydrocele.—In this form of hydrocele fluid is effused into an adventitious cyst distinct from the vaginal sac, developed in the areolar tissue beneath the visceral portion of the tunica vaginalis investing the head of the epididymis. As the cyst enlarges, the epididymis becomes flattened and displaced to one side, whilst the testicle is found either in front or at the bottom of the cyst. The fluid contained in the sac differs from that of vaginal hydrocele in being less in quantity, perfectly limpid and colourless, and nearly free from albumen. The fluid sometimes contains spermatozoa in great abundance, rendering it opaque and milky-looking. Their presence is owing to the rupture of one of the tubes of the epididymis, and the escape of semen into the sac of the hydrocele.

Diagnosis.—An encysted hydrocele is distinguished from vaginal hydrocele by the position of the testicle at the bottom of the tumour; and generally by the colourless character of the fluid evacuated.

Treatment.—When large in size, so as to be inconvenient, encysted hydrocele may be treated in the same way as vaginal hydrocele, and injection is attended with the same success.

Hydrocele of the Cord.—Hydrocele occurs in the spermatic cord in two forms—*diffused* and *encysted*.

The *diffused*, which is very rare, is simply an œdema of the areolar tissue of the cord.

Encysted hydrocele of the cord arises from a collection of fluid in the unobliterated funicular process of peritoneum, which is carried down in the natural transition of the testicle. It produces a small swelling in the cord, of an oval form, above and distinct from the testicle, more or less transparent, and quite movable. The swelling, when small, is of no importance; and it seldom requires treatment. *See* Testes, Diseases of.

T. B. Curling.

HYDROCEPHALOID DISEASE.—This term is one which has been applied to a set of symptoms, ill-defined in their mode of grouping, occasionally met with in delicate children soon after they have been weaned. The symptoms may in some cases have been due to reflex disturbance of the nervous system induced by improper food; they may appear as the sequence of some exhausting disease, such as a prolonged diarrhœa; or they may be concomitants of a pneumonia in its initial stages. In each of these, as well as in other allied conditions, there may be a febrile elevation of temperature; combined, in the first place, with undue irritability and extreme restlessness, whilst later on signs of mental sluggishness and stupor may supervene. Such symptoms are apt to be met with where, in addition to a depression of the vital powers, there is a reflex disturbance of brain-functions. The condition was specially described by Marshall Hall, by whom the above name was given. It may be well, therefore, to quote from his own description:—

'This affection may be divided into two stages: the first that of irritability; the second that of torpor. In the former there appears to be a feeble attempt at reaction; in the latter the powers appear to be more prostrate. These two stages resemble in many of their symptoms the first and second stages of hydrocephalus respectively.

'In the first stage the infant becomes irritable, restless, and feverish; the face flushed, the surface hot, and the pulse frequent; there is an undue sensitiveness of the nerves of feeling, and the little patient starts on being touched or on hearing any sudden noise; there are sighing and moaning during sleep, and screaming; the bowels are flatulent and loose, and the evacuations are mucous and disordered.

'If through an erroneous notion as to the nature of this affection, nourishment and cordials be not given, or if the diarrhœa continue, either spontaneously or from the administration of medicine, the exhaustion which ensues is apt to lead to a very different train of symptoms. The countenance becomes pale, and the cheeks cool or cold; the eyelids are half-closed, the eyes are unfixed and unattracted by any object placed before them, the pupils unmoved on the approach of light; the breathing, from being quick, becomes irregular and effected by sighs; the voice becomes husky, and there is sometimes a husky, teasing cough; and eventually, if the strength of the little patient continue to decline, there is a crepitus or rattling in the breathing. The evacuations are usually green; the feet are apt to be cold.'

But in such groups of symptoms there is nothing distinctive; and the term hydrocephaloid, which is now seldom heard, might be discarded. Its use can scarcely be justified merely on the ground that the symptoms met with under such conditions are apt to be occasionally confounded with those which usher in the commencement of acute hydrocephalus. We do not diminish the difficulties—already sufficiently pronounced—besetting the early diagnosis of this latter affection, by endeavouring to group together under one name a set of symptoms which, on different occasions, have no other common bond than that they are apt to occur in delicate children, the tone of whose nervous system has been lowered, and thereby rendered more irritable than natural. We should be really better without such a name, especially now that bleeding and lowering treatment are no longer in vogue for the amelioration of the grave organic affection with which the states in question may occasionally be confounded. H. Charlton Bastian.

HYDROCEPHALUS, Acute (ὕδωρ, water, and κεφαλή, the head).—A synonym for Tubercular Meningitis. Tuberculosis *plus* a meningeal inflammation is the generating condition; and acute hydrocephalus is only the occasional, though very frequent, concomitant. *See* Meningitis, Tubercular.

HYDROCEPHALUS, Chronic.—Synon.: Water on the Brain; *Hydrops Capitis*; Fr. *Hydrocéphale*; *Hydropisie du Cerveau*; Ger. *Der Wasserkopf*; *Hirnwassersucht.*

Definition.—A gradual accumulation of serous fluid within the lateral and third ventricles of the brain; causing them to become more or less distended, and the head enlarged; occurring principally in infants or very young children; and leading to restlessness, irritability, or convulsions, followed by dulness, drowsiness, motor weakness or actual paralysis, together with failure of mind and of the special senses.

The essential condition in this malady is the intra-ventricular effusion. The cases in which the fluid has been found outside the brain and within the arachnoid sac are, in all probability, merely examples of the disease in which intra-ventricular effusion having previously been well-marked, the distended corpus callosum, or, it may be, the floor of the third ventricle has given way, and allowed the fluid to pass beneath the arachnoid. The so-called extra-ventricular form of the disease is, therefore, in the majority of cases, merely a secondary and altogether accidental condition.

As a sequence of a large arachnoid hæmorrhage, serous fluid may also be found within the arachnoid cavity; this, however, is a condition which has no real title to be mentioned under the head of chronic hydrocephalus, as some writers have done. And the same remark applies to those accumulations of serous fluid which take place beneath the arachnoid, as a sequence of wasting or atrophy of the cerebral hemispheres, one or both. The collection of fluid in such cases is to be regarded as a simple sequence of the atrophy, and is of itself unproductive of morbid symptoms

Ætiology.—Two principal groups of causes are appealed to as productive of chronic hydrocephalus. In certain cases the affection is believed to be *idiopathic*, due to an 'essential dropsy,' occasioned by an inflammatory affection of the lining membrane of the ventricles. In other patients, however, this affection is distinctly secondary or *symptomatic*, and then may be caused by one or other of two principal sets of conditions. Thus (1) it is often occasioned, as writers of the last century pointed out, by the pressure of scrofulous or other tumours upon the 'straight sinus,' producing mechanical congestion of the great veins of Galen as well as of their radicles on the walls of the lateral ventricles, and, as a conse-

quence, an increasing dropsical condition of the ventricles themselves. (2) More rarely it seems to be produced or to remain as a sequence of an attack of acute hydrocephalus. This latter mode of origin is admitted by some authors, and denied by others. It is at least a possible mode of origin, although one which is difficult to be established with certainty. By far the largest percentage of cases probably belong to the first set of the 'symptomatic' category.

The disease is sometimes congenital, and may be so far developed during uterine life as to cause great difficulties in parturition—frequently necessitating the sacrifice of the life of the child. At other times the enlargement of the head begins to show itself soon after birth, or at some period before the end of the first or second year. Or it may reveal itself later still in childhood; much more rarely during adolescence; and more rarely still in adult life.

Congenital 'microcephalism' must not be confounded with hydrocephalus. It is true that in certain small-headed infants, having the cranium malformed and the sutures ossified, an excess of fluid may be found within the head; but then the fluid in these cases is situated outside the atrophied brain, and not within the ventricles. The two conditions are, in fact, totally opposite in nature.

Anatomical Characters. — Three different states, in regard to size of head, have been described as existing in this affection:—(1) where the head is smaller than natural; (2) where the head is of natural size; and (3) where the head is more or less considerably enlarged.

Those of the first category ought not to be included at all. They are the cases of 'microcephalism' above referred to. Those of the second category could never be diagnosed with any degree of positiveness during life; and it may, indeed be questioned whether such cases exist to any large extent, except as more or less transitory stages of instances of the disease pertaining to the third of the above categories.

Of course, in all the cases in which the head ultimately becomes enlarged from the presence of an excess of fluid within the lateral and third ventricles, there must have been a stage during which these ventricles were merely full of fluid, and during which pressure-symptoms were more or less marked—even without the existence of actual enlargement of the head. Such symptoms alone, however, do not often form a sufficiently precise combination to enable us to do more than entertain a vague suspicion that we may have to do with a case of chronic hydrocephalus. We mostly need the objective sign of enlargement of the head, to enable us to arrive at a positive diagnosis of this disease; but as soon as this sign declares itself to a well-marked extent, there are few affections of the brain which can be diagnosed with more certainty than the one which we are now considering.

Even the cases in which the head is distinctly enlarged differ amongst themselves, since in some of them (*a*) both sutures and fontanelles are widely open; whilst in others (*b*) the sutures, and perhaps the fontanelles, are completely closed. It seems probable that the latter may represent conditions into which some of the former pass, when the disease lapses into a chronic and stationary condition.

Owing to the separation of the cranial bones in young infants, this disease, when it occurs in them, soon becomes associated with an actual enlargement of the head, which increases rapidly. In consequence of the distending pressure from within, caused by the increasing size and fulness of the ventricles, the bones entering into the formation of the vault of the cranium become separated from one another, though the bones of the face remain unaltered. The frontal, parietal, the superior part of the occipital, and a small part of the squamous portion of the temporal bones become expanded and thinner than natural, at the same time that they are separated from one another—especially in the regions of the anterior and posterior fontanelles, and of the sagittal suture. In such regions, when the enlargement is extreme, a sense of fluctuation is often recognisable. The forehead becomes prominent and overhanging, whilst the eyeballs are depressed; and as the face remains unaltered or even becomes emaciated, it seems altogether unnaturally small, and thus contributes to produce a most characteristic appearance ('facies hydrocephalica'), which is often intensified by the old-looking, and more or less blank, expressionless, aspect of the face.

The cranial bones are often very thin, but occasionally they may be unusually thick throughout—even in young children.

The circumference of the head, even of a young child, may in hydrocephalus easily reach 24 to 30 inches or even more. Where the enlargement becomes extreme, the weight of the head is so great that it cannot be maintained in the upright position. It has to be supported by the hand or some artificial support; or else the child does not attempt to rise from the recumbent position. The size attained by the head in certain cases has been comparatively enormous; thus, in an altogether exceptional case, recorded by Cruikshank, it is said to have measured, in a child sixteen months old, no less than 52 inches in circumference, and the amount of fluid contained within the cranium was found to weigh as much as twenty-seven pounds.

The fluid is generally slightly albuminous; possesses some saline constituents; and has a specific gravity ranging from 1,006 to 1,014. Its composition agrees pretty closely with that of dropsical fluids generally.

In the great majority of cases, as already stated, the fluid is contained within the more or less distended lateral and third ventricles of the brain. The upper and lateral parts of the cerebral hemispheres, as well as the corpus callosum become thinned and distended, so as to resemble a mere bag, the walls of which are represented externally by pale unfolded and much flattened convolutional matter, and internally—next the fluid itself—by the lining membrane of the ventricles. This latter has become much thicker and tougher than natural; it may also be more or less granular on the surface; and often shows an increased number of distended vessels. These appearances are, however, not to be taken as an indication of the inflammatory origin of the malady, as some observers seem to suppose. They may be found, as the writer has seen, well-marked

in cases where the effusion and distension has been the result of a mere mechanical congestion, produced by pressure upon the commencement of the straight sinus, owing to a tumour in the middle lobe of the cerebellum. On the other hand, some years ago the writer examined the head of a hydrocephalic child who died in University College Hospital, in whom the most careful search revealed nothing that could have produced mechanical congestion, and in which there was, moreover, no sign of anything like an inflammatory condition of the walls of the greatly distended lateral ventricles. To fall back upon the hypothesis of an 'essential dropsy' was felt to be far from satisfactory. Such a phrase cannot indeed be regarded as conveying any real explanation of the condition in question.

The shape of the ventricles and of the compressed ganglia about the base are, of course, greatly altered. The foramen of Munro may be half an inch or more in diameter. The optic and olfactory tracts and lobes are also often much altered by pressure.

The brain-substance may be even tougher than natural, because the long-continued mechanical congestion, which exists in so many cases, favours the overgrowth of the neuroglia; and, indeed, it would appear probable that in some instances the overgrowth of this mere connective substance is well-marked. For, notwithstanding all the pressure upon and distension of the brain-substance, this rarely shows signs of atrophy. It is rather the reverse. The mere brain alone of a hydrocephalic child, after the fluid has been evacuated, commonly weighs more than the brain of a healthy child of the same age. Thus in an instance that came under the writer's notice, the brain of a child five years of age weighed rather more than 52 oz.

In those cases in which during life the fluid has escaped from the ventricles through a rupture in the corpus callosum, the brain has been found more or less flattened and collapsed in the lower part of the enlarged cranium, whilst the escaped fluid occupies the arachnoid cavity above it.

Symptoms.—Chronic hydrocephalus begins to manifest itself in various ways, and also, as above stated, at various ages. The great bulk of the cases are either congenital, or commence before the fifth month. But in certain rare instances, the head may begin to enlarge long after the union of the sutures, in early adult life, or even beyond middle age.

As to modes of commencement, at least four, pretty distinct from one another, may be encountered. (1) The disease may be ushered in by a period of fretfulness and irritability, with or without the occurrence of convulsions and strabismus, before any enlargement of the head is detected. Or (2) slow enlargement of the head may be noticed as the first event. In some cases, this enlargement not only sets in, but may continue for months, till notable increase in size has taken place, and yet the child may exhibit no morbid symptom whatever. The writer has seen a well-marked instance of this in a child whose head had been enlarging for eighteen months (the process beginning when it was a year old), and in whom, though the head was twenty-four inches in circumference, no other morbid signs or symptoms presented themselves. (3) Chronic hydrocephalus may supervene in a child after a fall, through the intermediation of cerebellar disease. The writer had under his care a little girl four years old, who, after falling from a table and striking the occiput severely, suffered for from twelve to eighteen months from symptoms indicative of cerebellar disease, after which the head began to enlarge, and hydrocephalus became the apparently dominant condition. Complete blindness ensued, then convulsions set in, and in the midst of one of these the patient died. A tumour of the middle lobe of the cerebellum was found, *plus* all the signs of a well-marked hydrocephalus. (4) The disease may occur as a sequence of an attack resembling acute hydrocephalus (tubercular meningitis): that is to say, a child appears to suffer for a time from what is regarded as tubercular meningitis; the symptoms then undergo some mitigation; they become more or less chronic; and ultimately the head begins to enlarge, as it does in chronic hydrocephalus. There is some doubt about the real nature of the starting-point in this mode of origin. The initial symptoms may not in reality have been those of tubercular meningitis. The chronic disease and its symptoms may occasionally be initiated in an acute manner.

It may be easily imagined that the subsequent course of the symptoms in persons suffering from chronic hydrocephalus, beginning in these various ways, may also be subject to great variations.

As the head enlarges, or as the pressure within increases, sensations of weight or pain may be experienced. The child may show increased fretfulness and irritability; or its manner may become more dull and heavy than natural. At other times there is no noticeable change in these respects.

In the 'symptomatic' forms associated with tumours, there is apt to be vomiting of a very obstinate and paroxysmal character, together with continuous pain, marked by exacerbations. Convulsions, either unilateral or general, may also occur, as well as paralysis of one or other of the ocular muscles. In such cases, too, in comparatively early stages, ophthalmoscopic examination will frequently reveal optic neuritis, which has a tendency to go on to white atrophy, with the production of more or less complete blindness.

In later stages of the disease mental action becomes increasingly impaired, there is loss of memory, dulness, and a great tendency to sleep during the day. There may be marked weakness or actual paralysis of limbs. Children affected to this extent often keep to the recumbent position, having at last no power of sitting up, or even of raising their head from the pillow. The appetite sometimes remains good; at other times it becomes much impaired, and a gradual emaciation ensues. Blindness, more rarely deafness, loss of smell, and impairment of other senses tend gradually to reveal themselves after a time.

Complications.—In all cases where the hydrocephalus is itself symptomatic of some primary intra-cranial disease, interfering with the proper return of blood from the ventricles and central portions of the brain, the symptoms resulting from this latter state of things are necessarily

complicated with others immediately produced by the original morbid condition. Hence the very great variations encountered in the grouping of symptoms in different cases.

Diagnosis.—Some remarks have already been incidentally made upon this subject under the head of *Anatomical Characters*.

Where the head becomes distinctly enlarged, with widely separated sutures and open fontanelles, there can be scarcely any room for doubt about the diagnosis. But before the head is distinctly enlarged, the diagnosis of chronic hydrocephalus with any degree of certainty is impossible. In many cases also where the head is only slightly enlarged, and the sutures are not opened, it may be very difficult, for a time, to pronounce an opinion as to whether or not an infant or young child is hydrocephalic. Natural variations in the size of the head are considerable; and it may also be enlarged from rickets, or from that very rare condition known as 'hypertrophy of the brain.' Even great thickenings of the bones of the head have occasionally given rise to uncertainties in regard to diagnosis. But in all these cases, in order to enable the practitioner to arrive at a trustworthy opinion, the particular form of the head has to be considered, together with the sum-total of the various symptoms which may have preceded or accompanied its increase.

Whether in any particular case we have to do with an instance of 'idiopathic' or of 'symptomatic' hydrocephalus, often cannot be settled; but in others it can be decided by reason of the existence of a set of symptoms distinctly pointing to the presence of an intracranial new growth.

Prognosis.—Hydrocephalus often proves fatal in the course of a few months; or it may be less rapid, entailing death only after a year or two. Its progress is variable, however. Remissions and stationary conditions are apt to occur, chequered by periods in which there are distinct exacerbations of all the symptoms.

Occasionally one of these stationary conditions becomes prolonged, and the individual may live for years. Some hydrocephalic subjects have subsequently lived on to the age of twenty, thirty, or even forty years. In a few exceptional cases a cure seems to have been effected, either naturally or under the influence of remedial agencies.

Death may take place in convulsions; from slow exhaustion with emaciation; or from intercurrent pneumonia or some other acute disease.

Treatment.—Very little, unfortunately, can be done, in the majority of cases, to produce decided or lasting improvement. This is especially so in those instances—only too numerous—in which the hydrocephalus is due to some scrofulous or other tumour interfering with the return of blood from the ventricles.

Blistering of the scalp, with mercurial inunctions, formerly much lauded, may do a great deal more harm than good; and the same may be said in reference to pressure of the enlarged head by strapping or bandages. This latter is a barbarously coarse method of treatment, which has happily fallen into disuse. Blistering may do good in some cases, but it should be cautiously had recourse to.

The general health of the child must be maintained as much as possible, by the aid, if necessary, of tonics and cod-liver oil. Purgation and diuretics may also be had recourse to. Iodide of potassium may be given internally in gradually increasing doses, as even young children bear this remedy well. Bromide of potassium will also help, perhaps, to mitigate vomiting and convulsions, when these are urgent symptoms.

It may be worth while in suitable cases to try the effect of greatly diminishing the amount of fluids taken, so as to reduce the fulness of the vascular system. The writer has had reason to believe that this method is well worthy of being attempted, where other means have failed, and where there is any chance of being able to carry it out.

Puncture of the head has been much lauded, and practised by many, but with an amount of failure and fatality that has caused the method almost to have fallen into disuse. If in any given case we could be reasonably certain that the hydrocephalus belonged to the 'idiopathic' variety (if there really are such cases), the method might be had recourse to, with much more chance of success than if it were occasioned by some mechanical pressure, which persists and prevents the return of blood from the central parts of the brain. Puncture of the head can scarcely be compared with puncture of the chest, because (even apart from the greater risks attaching to the former operation), a puncture of the chest in a case of pleurisy has a fair chance of being actually curative, whilst puncture of the head in hydrocephalus, in the majority of cases and for the reason above indicated, could only be palliative. Still the cases of this disease are so grave that where the sutures are opened, where the patient's condition is rapidly getting worse, and death seems otherwise inevitable, the question of performing the operation, at least once, ought to be entertained as a barely possible means of affording relief.

H. Charlton Bastian.

HYDROMETRA (ὕδωρ, water, and μήτρα, the womb).—Dropsy of the womb. *See* Womb, Diseases of.

HYDRONEPHROSIS (ὕδωρ, water, and νεφρός, the kidney). Synon.: Dropsy of the kidney; Fr. *Hydronéphrose*; Ger. *Hydronephrose*.

Definition.—A chronic disease of the kidney, caused by obstruction of the ureter; consisting in dilatation of the pelvis, and commonly of the ureter, with more or less extensive atrophy of the substance of the organ; usually affecting one kidney, sometimes both; characterized clinically by the presence of a soft fluctuating tumour in the renal region, but most distinctively by sudden discharge of urine with collapse of the tumour; and resulting, if not relieved, in complete destruction of the kidney.

Ætiology.—Among the most common causes of hydronephrosis are obstruction of the ureter at its lowest part, in consequence of pressure by new formations, particularly carcinoma of the uterus; the impaction of calculi of various kinds; and tumour of the ovary. More rarely it is induced by new formations in the bladder; stricture of the urethra; the pressure of the

pregnant, prolapsed, or retroflexed uterus; and exceptionally it is met with without apparent cause. In such cases it is to be referred to some contraction, due to inflammation or other cause, which has disappeared. The condition is also sometimes congenital, being due to malformations, such as impermeable ureter, or valve-like obstruction to the passage of urine downwards. From whatever cause the obstruc- may spring, accumulation of urine takes place behind it, leading to gradual distension of the organ. *See* URETERS, Diseases of.

ANATOMICAL CHARACTERS.—In the earlier stage of hydronephrosis there is simple dilatation of the pelvis of the kidney. As the disease advances, the dilatation increases, the organ becomes more and more distended, and the ureter often becomes so dilated or elongated as to present the appearance of a bluish-white tube, as large as or even larger than the inferior vena cava. Coincidently with this distension the substance of the kidney atrophies. At first the apices of the cones become flattened and wasted, but gradually the renal substance becomes more involved, until at length, in old-standing cases, scarcely any trace of it remains, and the kidney is represented by a large lobulated bag, whose fibrous walls are distended by clear fluid. Commonly one kidney only is affected, especially when extreme dilatation exists, but in some instances both kidneys are involved. There is a case on record where the whole abdominal cavity was occupied by an enormous tumour, containing sixty pounds of fluid.

SYMPTOMS.—In the slighter cases of hydronephrosis there are no symptoms of such a kind as to attract attention. This condition is often an unimportant complication of other serious diseases. In the more severe cases there are no constitutional symptoms, but the local changes are well-marked. There is a tumour situated in the lumbar region, extending upwards, downwards into adjacent regions, or forwards towards the anterior abdominal wall. The colon is usually in front of the tumour, and always displaced and compressed, so that constipation frequently coexists with hydronephrosis. The mass is often lobulated, always undulating in character; and frequently fluctuation may be detected. The most conclusive evidence of the condition is afforded by the discharge of a large quantity of urine, generally of low specific gravity, and often containing mucus, coincidently with the disappearance or diminution of the tumour. It sometimes happens that the obstruction is permanently removed, and dilatation alone remains as evidence of the old obstruction. Hydronephrosis, when double, sooner or later proves fatal by suppression of urine or uræmia. When only existing on one side, it has proved fatal by pressure upon neighbouring parts; by the supervention of impaction of stone in the kidney of the opposite side; or from other causes.

DIAGNOSIS.—The distinction of hydronephrosis from ascites may be sometimes difficult when the disease affects both sides. The diagnosis is partly to be made by observing the effects of change of posture, hydronephrosis being much less influenced thereby than ascites. The history and mode of origin of the affection also afford indications. From hydatids of the kidney it is sometimes impossible to discriminate hydronephrosis, but the history of the case and the characters of the urine often afford a clue. If there be tumour on both sides, it is extremely unlikely to be hydatid. From ovarian tumour the diagnosis is to be made by the history of the case; the position of the mass; its relations to the colon; and by vaginal and rectal examination. From perinephritic abscess hydronephrosis is distinguished by its being less hard, and by the absence of pain and fever.

PROGNOSIS.—The prognosis is always serious; but if one of the kidneys be sound it becomes enlarged, and does double work, and so long as this condition continues, the patient may suffer little inconvenience.

TREATMENT.—Careful manipulation of the tumour is often useful in extreme conditions; and tapping with the aspirator may be employed.

T. GRAINGER STEWART.

HYDROPATHY (*ὕδωρ*, water, and *πάθος*, a disease).—A synonym for hydrotherapeutics. *See* HYDROTHERAPEUTICS.

HYDROPERICARDIUM (*ὕδωρ*, water; and *pericardium*, the pericardium).—An accumulation of serum in the pericardium, either dropsical or inflammatory. *See* PERICARDIUM, Diseases of.

HYDROPHOBIA (*ὕδωρ*, water, and *φόβος*, fear).—SYNON.: Rabies; Dog-madness; Fr. *Lyssa; la Rage*; Ger. *Hundswuth*; *Wasserscheu*.

DEFINITION.—An acute disease, produced by the inoculation of a specific animal poison; manifesting itself by symptoms due to disturbance of the central nervous system; and almost invariably proving fatal.

ÆTIOLOGY.—Never spontaneous in man, the sole cause of hydrophobia is inoculation with the poison of a rabid animal, almost invariably with the saliva, the inoculation being commonly effected by a bite. In about nine-tenths of the cases, the disease is contracted from dogs; in most of the remainder from cats; in very few cases from foxes or wolves. It has been acquired from a wound received during the dissection of a rabid animal. It is probable, although not certain, that inoculation with the blood of a rabid animal will produce the disease. The poison is not *known* to be present in any other secretion than the saliva. Commencing decomposition is said to destroy its activity, but it is probable that the dried saliva will retain its virulence for a considerable period.

Inoculation takes place more certainly by a bite on an uncovered part of the body, as on the hands and face, than by a bite inflicted through the clothes. It may occur without a bite, as by a lick upon an abrasion. It has followed the scratch of a cat, probably by the animal's saliva being thus inoculated. A healthy dog has communicated the disease by a bite given immediately after it had been fighting with a rabid animal, the saliva of which, no doubt, was hanging about its jaws. The disease has resulted from the teeth being used to loosen a knot upon a rope with which a rabid dog had been tied.

It has been asserted that the disease may

arise from the bite of a healthy dog, but this is improbable. Cases are on record, however, in which the disease has followed the bite of a dog, which did not at the time, or for several weeks afterwards, present the recognised symptoms of the disorder. It seems possible that in rare cases rabies may affect a dog as a mild and insignificant malady.

When no preventive measures are adopted, at least half, perhaps two-thirds, of persons bitten escape. The immunity may be due partly to the bites being inflicted through clothes; partly to individual insusceptibility, which has been found to exist in animals as well as in man. When preventive measures are adopted as soon as possible, the proportion of those who escape is much greater.

More males than females suffer, the proportion being three to one. So, too, in dogs. The largest number of cases occur in the middle period of life, doubtless from greater exposure to the cause. Children, however, often suffer, being helpless and bitten about the face. Most cases are contracted from straying or pet dogs.

The *period of incubation* is longer than that of any other acute specific disease, and is singularly variable. It is rarely less than a month, the shortest on record having been about twelve days. The average period is six or seven weeks. In about half the cases it is between one and three months. In some cases it is longer, reaching six, nine, or twelve months. Cases have been recorded in which two, three, five, and even ten years intervened. Most authorities believe that such cases were either not true hydrophobia, or were due to a second unknown infection. If we admit, however, as we must do, that twelve or eighteen months may elapse, we can scarcely deny the possibility, or even probability, of longer periods. It is as hard to explain an incubation period of one year as of five years.

Anatomical Characters.—General fluidity of the blood, such as is met with after death from acute septic diseases; redness of the throat and pharynx, and occasionally of the salivary glands; together with, in some cases, evidence of congestion of the brain and spinal cord, constitute the chief morbid appearances visible to the naked eye. The microscope has shown that there is evidence of inflammation (congestion and leucocytal infiltration) in the salivary glands (Coats); and that minute changes in the nerve-centres are almost constantly to be found (Clifford Allbutt, Hammond, Benedikt, Coats, and the writer). Of eight cases examined by the writer, the minute changes in seven were distinct, and in character and position so far characteristic that, given the fact of an *acute* disease, a *post-mortem* diagnosis might, in the vast majority of cases, be made with certainty by the microscope. The essential change consists in the accumulation of leucocytes around the vessels, and their infiltration into the adjacent tissue; this change having a special distribution, being either confined to, or most intense in, the region of the medulla which is contiguous to the lower part of the fourth ventricle, that is, the neighbourhood of the respiratory centre. Here we have also the convulsive centre, and the centre for deglutition. The change is most intense in the hypoglossal, glosso-pharyngeal, and vagal nuclei and their neighbourhood. There is little or no change in the upper part of the medulla, corpora quadrigemina, cerebellum, or basal ganglia. In the convolutions a similar but slighter alteration is present in some cases. It may occur throughout the grey matter of the cord, but is here usually slight, and often absent. In the most affected regions, traces of *ante-mortem* clots and even of inflammation of the walls of the minute vessels may be found in some cases. Perivascular areas of disintegration are common; but such frequently occur apart from hydrophobia or any other disease. Minute extravasations are common, partly mechanical. The only change in the nerve-elements themselves consists in a granular degeneration of the ganglion-cells of the regions chiefly diseased. In the dog the changes are quite similar in characters and distribution.

Symptoms.—During the period of incubation of hydrophobia there are commonly no symptoms. Vesicles under the tongue were formerly described, but their occurrence has not been confirmed. Occasionally pain and discomfort have been felt in the seat of the wound, explicable, in part, by the attention directed to it. Mental depression has been noted, also probably due to anxiety regarding the possible consequence of the bite.

The onset of the acute symptoms is commonly attended by no local disturbance, sometimes by pain, rarely by actual inflammation, in the wound. The first evidence of the impending disorder is usually malaise, mental depression, disturbed sleep, and some discomfort about the throat, with a difficulty in swallowing, especially liquids. The attempt occasions some spasm in the throat, which soon, if not at first, involves the muscles of respiration, causing a short, quick inspiration, a 'catch in the breath,' resembling that due to an affusion of cold water. In a few hours this increases to a strong inspiratory effort, in which the extraordinary muscles of respiration take more part than the diaphragm, the shoulders are raised; the angles of the mouth are drawn outwards. The saliva, which is abundant and viscid, cannot be swallowed. It hangs about the mouth, and the patient is annoyed by his efforts to get rid of it. As the intensity of the spasm increases, so does the readiness with which it is excited. The mere contact of water with the lips, or cutaneous impressions, as a draught of air, will bring on a paroxysm. The distress it occasions leads to a mental state which increases the readiness with which the spasm is produced. The mere sight of water, or the sound of dropping water, will cause it (hence the name), and even analogous visual impressions, as a sudden light or the reflection from a looking-glass. Thus the respiratory spasm excited by swallowing liquids, which is, as it were, the key-note of the disease, extends on the one hand to widely-spread muscular spasm, and on the other to mental disturbance. In each of these directions the symptoms develop. The spasm, from being limited to the muscles of respiration, may become general and convulsive (tetanoid or co-ordinated) in character; still excited by the same causes. The mental distress passes into disturbance, in which the balance of reason is

lost, continuously or during the paroxysms. In the frenzy, the horror of the distress is transferred to the attendants by whom any discomfort may have been occasioned, and during the paroxysms the patient may attempt to bite them, and even others. Consciousness may so far remain that in the intervals he may beg those whom he regards to keep away. The saliva is ejected with force, and the patient hawks it up with a noise 'like a dog.' The sight of a dog has been known greatly to intensify the disturbance; and this, strangely enough, in cases in which the sufferer had no suspicion of the nature of his affection. The delirium may, in some cases, be continuous and violent. As the mental disturbance increases, the respiratory spasm and convulsion may lessen, or the latter may persist to the end.

Vomiting is common, and is often an early symptom, a greenish-brown liquid being ejected. Priapism or nymphomania occasionally occurs. The temperature is usually raised two or three degrees. Albumen is often present in the urine; and sometimes sugar.

Duration and Terminations.—The duration of hydrophobia is usually from one to four days; sometimes it lasts six, eight, or ten days. In the rare cases which have recovered, the duration of the acute affection has been from four to ten days, although slight spasmodic symptoms have lasted for a longer time, as does the spasm of whooping cough.

The common cause of death is exhaustion from the attacks of fury and convulsion, often aided by manifest cardiac failure, which may occur early, and be out of proportion to the general asthenia. Sometimes the patient has died asphyxiated in a paroxysm of respiratory spasm; partly, perhaps, from spasm of the glottis.

Varieties.—The relative degree of the above-described symptoms varies in different cases. The mental disturbance, or general muscular spasm, may, respectively, predominate over the respiratory throat-spasm, even in the early stages, and may impress a special character on the attack, so that it resembles in the one case a primary mental affection, in the other general convulsive affection, as tetanus.

Pathology.—We know nothing of the nature of the poison of rabies. It has been thought that it is not at once generalised, but develops in the wound, and subsequently affects the system. The symptoms indicate a primary action on the nerve-centres, especially on the respiratory region of the medulla, spreading more widely, in its ultimate action, in the medulla and to the brain and cord. The vascular changes, from their variability and occasional absence, are probably secondary effects of the disturbed action of the nerve-centre, produced by the poison carried by the blood.

The first effect of the poison is probably to lessen the 'resistance' of the medullary centres. Their action becomes spasmodic; is excited with undue readiness, especially by reflex influences; and spreads too widely. The secondary vascular changes may have their own effects. They are, as in other functional diseases, somewhat random in distribution within the affected area. By the infiltration of leucocytes, the tissue may be broken up, and what are practically minute points of suppuration may result. If the part damaged is important, grave consequences may ensue. The nucleus of the pneumogastric is often so damaged, and thus we can understand the occurrence of cardiac failure. The changes in the convolutions and the spinal cord are probably proportioned to the mental or tetanoid symptoms respectively. The mental excitement no doubt acts upon and increases the irritability of the medulla (Putnam). Conversely, the disturbance of the latter may help to determine the *direction* of the mental disturbance due to the poison.

Diagnosis.—The symptom of greatest diagnostic value is the respiratory spasm excited by attempts to swallow, increasing until it resembles a convulsive action, and accompanied after a time by mental disturbance. In certain diseases of the throat and chest, especially œsophagitis and pericarditis, a reflex throat-spasm may occur, but in such cases there are commonly pain or other obtrusive signs of the local affection. When the mental disturbance occurs early, the affection may be confounded with acute mania: the association with slight respiratory spasm is still the most important diagnostic indication. In cases (if such occur) in which this symptom is absent, the diagnosis is a matter of great difficulty, and can only be made by the history of the antecedent bite, the rapid course of the disease, and its association with other convulsive phenomena and with salivation. From tetanus, hydrophobia is distinguished by the late period after the bite at which the symptoms develop; the absence of trismus and of continuous spasm; and the presence of paroxysmal respiratory spasm, of aversion to liquids, and of mental disturbance. Too much weight must not be given to the general character of the convulsive symptoms, if other signs of the disease are present, since there is probably a tetanoid form of hydrophobia, in which general spasms occur early; but they intermit, and are excited by attempts at deglutition, and there is no trismus. Organic brain-diseases accompanied by delirium and convulsions, occurring after a bite, have been mistaken for hydrophobia, as in a case in which the nature of the disease was only discovered when, after exhumation, meningeal hæmorrhage was found. Here also the respiratory spasm is absent.

Mere mental excitement, directed to the disease, may determine symptoms of dysphagia somewhat resembling the genuine disease—'spurious hydrophobia' as it has been termed. After a period of anxiety regarding the consequences of a bite, spasm in the throat is felt in swallowing. The patient's fears are intensified, the symptom increases, and even the medical attendant may be deceived. The spasm, however, is not of the respiratory character of genuine hydrophobia. Recovery commonly ensues on the mind being tranquillised, or by the application of some remedy in which the patient has confidence. It must be remembered that in some cases of genuine hydrophobia the influence of the patient's mental state has been very clearly traceable even in the early symptoms.

The distinction of genuine from spurious hydrophobia is often rendered difficult by the

fact that the latter usually follows suspicious bites, and that the former may be distinctly intensified by the patient's nervous fears. The untypical character of the spasm in the spurious disease (mere dysphagia); the fact that an effort removes this difficulty, and that once overcome it does not return; the stationary condition; the absence of mental symptoms beyond anxiety; and the disappearance of the symptoms when this is removed, are the important guides.

Prognosis.—Hydrophobia is practically fatal, but not certainly so; and the patient personally should unquestionably receive the 'benefit of the doubt.' Cases differ in the intensity and rapidity of their course; and the less rapidly the symptoms are evolved, the greater is the hope, slight though it still is, that an exception to the common fatality may be obtained. The prognosis is better the longer the spasm remains limited; it is worse if there are general convulsions, mental disturbance, and signs of exhaustion or of disproportionate heart-failure.

Treatment.—Adequate measures against the spread of rabies would undoubtedly lessen, perhaps entirely prevent, the occurrence of hydrophobia in man; but the discussion of these is beyond the scope of this article (*see* Rabies). When a person has been bitten by a suspicious or doubtful animal, the circulation in the part should, if possible, be at once arrested by a tight ligature above the place; the wound should be washed; and then it should be allowed to bleed freely. It may probably be sucked with impunity if the mouth is rinsed with water, or better still with vinegar and water, after each act, and if there are no abrasions in the mucous membrane. The act has been supposed to be dangerous; but all experience is opposed to this. Poisons have to remain for some minutes in contact with a mucous membrane before they are absorbed, and during the act of sucking there is a flow from the mucous membrane into the mouth, which must be opposed to absorption. As soon as possible the wound should be cauterised. Of chemical caustics, nitrate of silver, freely applied at once, is probably effectual. If any time have elapsed, nitric acid or liquid carbolic acid is preferable. The actual cautery, applied deeply and freely, is an efficient and ready means. If practicable, free excision of the bite is wise; and should not be neglected, even though the cautery has before been used, if there is any doubt as to the thoroughness of the application.

The methods adopted for the treatment of the developed disease have been numerous. All so-called 'specifics' have been proved to be useless. An attempt has been made to eliminate the poison by administering large doses of mercury, and by diaphoresis. The two have been combined in the mercurial vapour bath. Two or three cases are on record in which this method has been successful; many in which it has been powerless. Of late it has been but little tried.

Attention has been lately directed to curara as a remedy for hydrophobia. First recommended half a century ago by an Englishman (Sewell), it was tried in small doses and failed. Niemeyer suggested larger doses, and in a case by Offenburg it was apparently successful; and since then another case, in America, has recovered under its use. In many cases it has failed—in all cases in this country up to the present time. It is recommended that it should be used in injections of from $\frac{1}{16}$ to $\frac{1}{3}$ of a grain, repeated every quarter or half an hour, until the severity of the paroxysms is lessened. This point may not, however, be reached until general muscular paralysis is imminent or produced, and then artificial respiration may be necessary until the effect has passed away. As often as this is the case, and the spasms recur, another injection must be given. In hydrophobia there is remarkable tolerance of the drug, poisonous doses (one grain repeated) of active curara having in one case been without any effect (Curtis). This is, perhaps, a hopeful fact, as it indicates that curara has an action to which the changes in the central nervous system are opposed.

Sedatives have been the remedies commonly employed, and of these the best are chloral and morphia. One case (probably genuine), in which morphia and calabar bean were used, recovered (Nicholls); and one in which chloral was employed lived for ten days (Sansom). The effect of the two on the respiratory centre in animals suggests their joint use. The morphia should be given by hypodermic, the chloral by rectal injection. Chloroform is useful in moderating the paroxysms, but appears somewhat inferior to chloral. Other sedatives—Indian hemp, &c.—have appeared of inferior value.

Cold affusions to the cervical spine and head were used in India in two cases which recovered, the throat and spine being blistered with nitrate of silver, and chloroform administered. Ice to the spine has been tried without effect. Tracheotomy was recommended by Marshall Hall in one case. Death from *laryngeal* spasm, is, however, too rare to justify the measure.

In all cases tranquillity is of the greatest importance. Every excitant of spasm should be avoided; the patient being kept in a dim still room, and friends as much as possible excluded. Next in importance is nourishment, which should be given by the rectum, if spasm is excited by the attempt to swallow. Restraint, which may be necessary, should be as little as possible, but it should be effectual.

The saliva of persons suffering from hydrophobia has been proved to be capable of communicating the disease to animals. Hence the attendants should be cautioned to have no uncovered abrasion on the hands, and to wash from the eyes or face any saliva which may have been spit on them; and if they are bitten by the patient, the wound should be treated as if it had been inflicted by a rabid animal. These precautions remove all danger; and any anxiety the subjects may feel may be relieved by the assurance, that of the thousands of persons who have attended on patients with hydrophobia, no authentic instance has ever been recorded in which the disease was contracted either by attendance during life, or inspection after death. W. R. Gowers.

HYDROPS (ὕδωρ, water).—A synonym for dropsy. *See* Dropsy.

HYDRORHACHIS (ὕδωρ, water, and ῥάχις, the spine).—A collection of fluid in the spinal canal. The term is commonly used as a synonym for spina bifida. *See* Spina bifida.

HYDROTHERAPEUTICS (ὕδωρ, water, and θεραπεύω, I treat).—SYNON.: Water-cure; Hydropathy; Fr. *Hydrothérapeutique*; Ger. *Wasserheilkunde.*

It would be out of place were we to enter here into a description of the sources and the composition of the numerous varieties of water used for hygienic and dietetic purposes; but we may refer to Dr. Parkes' instructive *Manual of Practical Hygiene.* We intend to divide this article into (1) a short sketch of the history of the water-cure or hydrotherapeutics; (2) notes on the internal use of water, and on the more common hydrotherapeutic procedures; and (3), a consideration of the morbid conditions suitable for hydrotherapeutic treatment.

History of the Water-cure.—Although the old Greek and Roman physicians occasionally employed water internally and externally in the treatment of disease, the systematic water-treatment seems to have gained ground for the first time in the 15th and in the beginning of the 16th century in Italy and France, and again after a period of oblivion in the 17th century, especially in England (Floyer, T. Smith), and in the beginning of the 18th century in Germany (F. Hoffmann). The next important scientific application we owe to J. G. and J. S. Hahn, who, towards the middle of the 18th century, treated febrile diseases with cold sponging, and were so convinced of the beneficial result, that one of them when attacked with typhoid fever subjected himself to this treatment. It fell, however, again into neglect, until towards the latter part of the 18th century, when Wm. Wright, James Currie, W. Jackson, and others resuscitated the cold water treatment in fevers, and strengthened their reasoning by thermometric observations. In spite of the results obtained, not only in England but also in Germany, amongst others by Reuss, Frohlich, Brandis, and Horn, the method was again falling into disuse, when, soon after 1820, a small farmer, Vincent Priessnitz, of Graefenberg, in Silesia, began to treat every kind of ailment, chronic as well as acute, with various hydrotherapeutic procedures, and added to the external applications the abundant internal use of water, combined with active exercise, and a very simple diet; prohibiting at the same time all alcoholic beverages, and also tea and coffee. Priessnitz gradually made considerable changes in his method of treatment. For the original packing during several hours in dry woollen blankets covered with feather-beds, and followed by cold affusions, he substituted packing in wet linen sheets during several hours, followed by a full bath or a douche; and at a still later period, he frequently employed cold wet packing of only 15 or 20 minutes' duration, repeated several times on the same day; he introduced also the method of rubbing the whole body with a cold wet or dripping sheet instead of the full bath, and made extensive use of partial baths, as hip or sitz baths, baths for the hands, the arms, the feet, wet abdominal belts, and wet compresses over different parts of the body. Priessnitz seemed to search for a universal method applicable to all cases. One of the guiding ideas was that disease of the most different nature was caused by an acrid humour in the blood, and that the skin was the organ through which this humour was to be removed.

Though the success of such treatment, combined with active exercise in a healthy mountainous country, and simple diet, was considerable in many cases, the indiscriminate, too energetic, and protracted use often led to unfavourable results, and the system was beginning to be regarded as a species of quackery, when, about thirty years ago, some establishments were placed under the superintendence of regularly educated physicians, who studied the physiological effects of the different forms of bathing, and modified them with regard to duration, temperature, &c., according to the requirements of individual cases, combining pharmaceutical remedies with hydrotherapeutic procedures when required. Thus a more or less modified water-cure has at last become a branch of rational medicine, at least in France and Germany; and a new impulse has been given to it lately, by the employment of various forms of baths in the treatment of fevers. In this country there is as yet, very little systematised relation between the special hydrotherapeutic and the general medical treatment; and the experience gained at hydrotherapeutic establishments is not communicated and discussed in our medical societies, and scarcely ever in the general medical journals. This is much to be regretted, for there can be no doubt that hydrotherapeutic measures might be more widely introduced with great advantage into our hospitals, as well as into our private practice; but this is not likely to be the case so long as the medical profession has not fuller opportunities for studying the effects of water treatment. The fault may lie to some degree in the nature of most of the establishments for the water-cure; but this might be remedied if more establishments were to be erected under the guidance of superior members of the profession—establishments where the usual medical treatment would in suitable cases go hand in hand with hydrotherapeutic management.

Internal Therapeutic Use of Water, and the more Common External Hydrotherapeutic Procedures.—The dietetic necessity of water is well known; life cannot exist without it; all our tissues contain an indispensable proportion of water; we constantly lose a large amount by respiration, and by all excretions; all the internal functions of tissue-change are dependent on a certain quantity of water; this want is supplied by the solid and fluid food which we take, water included; while temporary excess of supply leads to increased discharge by the excretions, and temporary deficiency to a diminution of the water of the excretions. An increased ingestion of water further leads, for a time at least, to an increased removal of the products of retrogressive tissue-change; the tissues and the blood itself are, so to speak, washed out by it; and, as the consequence of the increased removal of the used-up material, the body is enabled to take in a larger amount of new substance, and hence we observe not rarely increase of weight as the effect of plentiful water-drinking, if not carried to excess as regards quantity and time; the secretions of the urine, bile, saliva, and pancreatic juice, appear to be increased by the abundant internal use of water, as well as the perspiration; though the latter to some degree requires the concomitant influence of high external temperature or bodily exercise.

Water has also an important share in all internal courses of mineral waters. Used by itself, it can exercise some good influence in cases of gout and gravel, in hæmorrhoidal complaints, imperfect secretion of bile, and constipation from sluggish peristaltic action. As, however, excessive water-drinking, according to Priessnitz's original plan, is apt to cause dyspeptic troubles, water is now, in general, used internally only either for dietetic purposes, or to assist in other courses of treatment.

The *external use* of cold water admits of a very great variety of applications, and a corresponding variety of effects on the body. The two main effects of the different forms of cold baths are *abstraction of heat*, with its further influences on the functions of the body; and *stimulation of the cutaneous nerves*, and through these of the nerve-centres. Both effects are usually combined, but in some forms of bath, the stimulation or the *exciting effect* preponderates; in others the abstraction of heat, with its *calming* or *depressing influence*. Hence the different forms of baths, or rather hydrotherapeutic procedures, may be divided into *stimulating* and *calming*, but it is to be borne in mind that there is no strict line of distinction. With this limitation we may regard as *stimulating*—the *full* cold bath of short duration, the stimulating action of which is increased by motion of the water, be it natural or artificially imparted; the rapid wash-down, either by means of a large sponge, or by means of a wet sheet, with or without friction; the spouting of the back, and the pail-douche; the needle-bath or circular shower-bath; the different forms of the rain-bath, and the usual shower-bath; the great variety of other douches; and the running or flowing sitz-bath. The immediate effects of these stimulating forms, in a constitution endowed with a certain amount of reactive power, are exhilaration, increased activity of circulation and muscular force, and improved appetite and digestive power. By altering the duration of the bath, and the temperature of the water, the effects may be considerably modified, and thus adapted to different conditions.

The more *calming* forms are—the wet sheet-envelope, entire or partial; the impermeable wet compresses; the full cold bath of long duration and without motion; the sitz, the shallow, and foot baths without motion; and the full bath of higher temperature. Depression through abstraction of heat exceeds the stimulation in these forms: diminution of nervous irritability, of sensation and mental activity, and of the frequency of the pulse and energy of circulation; a feeling of lassitude; and a tendency to sleep, are the principal effects. These forms can, however, be modified, and the effects vary in proportion. Thus the wet sheet-envelope allows ample variation by using warm or cold water, by using the sheet dripping or wrung out, by making the sheet fit tightly round the neck, by moving the sheet to and fro, by frequently changing the sheet, &c. The calming and stimulating form may be further combined by using, first, the wet sheet-envelope, or the woollen blanket-envelope, for a sufficient period to produce perspiration; and then a more or less cold bath or shower-bath of short duration. The physician has, indeed, infinite varieties of application at his disposal, to be used according to necessity.

Powerful and most important hydrotherapeutic helps are the different vapour- and hot air-baths (Russian, Roman, Turkish baths), combined with douches and baths of various temperatures. These kinds of baths are, however, treated of in another article. *See* BATHS.

A plain nourishing diet, without or with only a limited amount of stimulants; outdoor exercise in proportion to the strength of the individual; and in some cases active or passive gymnastics, are likewise to be regarded as valuable adjuvants in the hydrotherapeutic treatment of chronic diseases; for muscular exercise means not only increased action, oxidation, excretion, and development of muscle, but also increased general circulation and respiration, increased inhalation of oxygen, and increased production of heat, so necessary in the cold water-cure. There is also no reason whatever why pharmaceutical remedies should not be combined with the water-cure treatment—a method which, as already mentioned, is frequently adopted in the best establishments.

Therapeutic Effects, and Morbid Conditions Suitable for Hydrotherapeutic Treatment.—The principal results of well-adapted courses of cold water treatment are:—improved nutrition and action of the skin; increased tone of the nerve-centres; regulation of the circulation; amelioration of the sanguification and nutrition; and acceleration of the retrogressive tissue-changes. It is essential for such successful results that the organism be able to stand a certain amount of abstraction of heat; that it be capable of more or less energetic reaction; and that the digestive and assimilative organs be able to take up a fair amount of nourishing material, which is required by the increased demand on the body.

Acute febrile diseases.—Amongst the oldest therapeutic uses of the cold bath, though it has only lately been more extensively revived, is the employment of different forms of cold baths in acute febrile diseases, attended with a high degree of pyrexia. The moderately cold or the cooled-down bath, as proposed by Dr. von Ziemssen of Munich, is the form principally employed; but cold affusions, the shower-bath, the wet envelope frequently changed, cold compresses, the application of ice in substance, washing with iced water, and iced enemas are likewise applicable; and the liberal internal allowance of cold water forms an important part of the dietetic management of this class of diseases.

Typhoid fever.—Typhoid fever is the disease in which this treatment, with numerous modifications, has been most generally adopted. As soon as the temperature of the patient reaches 102·0° to 103° Fahr., he is placed in a bath of about 90° Fahr., and the temperature is gradually cooled down, by the addition of cold water, to 80° or 60° Fahr., according to the patient's power of reaction. The patient is kept in the bath generally from 10 to 15 or 20 minutes, when slight shivering often manifests itself. The patient's temperature, measured in the rectum, is usually reduced by this procedure about 1½° to 5° Fahr., not immediately, but within the first hour after the bath. As often as the temperature may again reach 102·0°

to 103°, the patient is again placed in the bath. Thus, during the height of the pyrexia three to five baths may be required in twenty-four hours, while later on about two are usually sufficient, and often only one. Instead of the bath gradually cooled-down, a bath of a temperature between 60° and 90° Fahr., may be given, according to the condition of the individual patient. The frequent and careful use of the thermometer is an essential element in this method of treatment, which may be, as it often is, advantageously combined with the administration of alcohol, quinine, and other remedies. The earlier the baths are commenced, the greater seems to be their influence in mitigating the severity of the disease and its sequelæ, and in shortening its duration. In the numerous accounts of German physicians (Brand, Ziemssen, Zimmermann, Jürgensen, Liebermeister, &c.) it is claimed that the mortality is considerably less with this than with the expectant or any of the other usual modes of treatment.

Hyperpyrexia.—A still bolder use may be made of the cold-water treatment, in those rarer cases of hyperpyrexia occasionally occurring in the course of rheumatic fever, when the temperature rises to 108° Fahr. and more; and where very cold and prolonged baths, the application of ice-bags, &c., appear to be the only means of saving life. (*See* Dr. Wilson Fox, *Treatment of Hyperpyrexia*; the writer's case in the *Clinical Society's Transactions*, vol. v.; and several other papers in the *Clinical Society's Transactions.*)

Scarlet Fever.—In scarlet fever we have found warmer baths (80° to 98° Fahr.) more generally applicable than quite cold or cooled-down baths, though in cases attended by a high degree of pyrexia and brain-symptoms these are preferable.

Hectic fever.—In hectic fever, connected with various chronic diseases, the effect of hydrotherapeutic treatment is less decided, and not yet sufficiently tested.

Digestive derangements of the most different kind, associated with *sluggish venous circulation* in the abdominal organs—conditions which may be grouped together under the term *abdominal venosity*, tendency to hæmorrhoids, to hypochondriasis, &c., are often the objects of the water cure, which may be useful by stimulating the physical and psychical energy of the nervous system, as well as the nutrition and tissue-change, by invigorating the skin. Habitual constipation from this cause is often relieved by the hydrotherapeutic belt. In this class of cases the common salt waters, and the alkaline sulphatic waters are more frequently used, and are often preferable; they may, however, be advantageously combined with judicious hydrotherapeutic treatment.

Chronic metallic poisoning may be treated in some cases with equal benefit, if there is sufficient reactive power, at cold water establishments, as at the thermal sulphur and simple thermal spas. The external hydrotherapeutic procedures aiming at increased perspiration and tissue-change, are in this class aided by the abundant internal use of water, in order to wash out the tissues, and especially the liver.

Skin-weakness or *atony of the skin* is often the cause of frequently recurring attacks of diarrhœa with neuralgic pains, of tendency to catarrh of the respiratory mucous membrane, and of rheumatism. Gently stimulating hydrotherapeutic appliances, with gradually increasing energy, are here mostly useful, unless, as in impeded convalescence, the reactive power is so reduced that the gaseous thermal salt baths and mountain-air are preferable, while in others sea-air and sea-baths are successful competitors of the water-cure.

Hysteria.—In hysteria and hysterical affections the water cure has obtained many good results, not by the internal use of water, but by the milder forms of baths. Functional hyperæthesia and anæsthesia, hemicrania, spinal irritation, intercostal neuralgia, and other forms of neuralgia depending on imperfect nutrition and tissue-change, are likewise often benefited.

Organic diseases of the nerve-centres are not suitable for treatment in cold water establishments, excepting occasionally for palliative purposes.

Rheumatism and gout.—In *muscular rheumatism* the original supporters of the water-cure considered their plan as infallible, but this is by no means the case. The diaphoretic methods, namely, the woollen blanket-pack and the wet sheet-envelope, often prove useful; but we know also of many failures in even good establishments. The exposure to all weathers during the cure ought certainly not to be imitated by such invalids, and the access of cold air to the wet body is to be more carefully avoided than it often is. The course must not be prolonged too much at one time, but may be repeated after an interval of months, which may be spent with advantage at sheltered seaside localities, at moderate elevations, with the help of pine-leaf baths, or at one of the gaseous thermal saline spas.

Rheumatic and *gouty swellings* of joints require great care in their management. The enfeebled invalid is rarely a fit object for the water-cure; but the stimulating local compress, more or less impermeable, is a useful element in the treatment of such cases.

Milder cases of *gout* may expect benefit from the usual hydrotherapeutic treatment, in so far as it aims at increased retrogressive tissue-change, and invigoration of the nervous system, especially if this treatment is associated with great moderation in the use of stimulants, and also of food in general; but local packing not rarely causes fits of gout. The more serious forms of gout are too much complicated with various defects of constitution to encourage us in recommending cold-water treatment.

Chronic affections of the skin.—In some diseases of this kind, such as prurigo, urticaria, eczema, and local perspirations, a more or less modified hydrotherapeutic treatment is an important adjuvant.

Syphilis.—The favourable results obtained in syphilis, or rather in the often complicated conditions of *lues*, have greatly contributed to the reputation of the water-cure; but the latter is only an excellent adjuvant to pharmaceutical treatment in these cases, in a similar way as the sulphur waters are; and many of the cures of so-called *lues* may be regarded as cures of *mercurialism.*

Catamenial irregularities are not rarely treated

at hydrotherapeutic establishments. Profuse menstruation is often checked by the regular use of the cold hip-bath of short duration, namely, three to five minutes; in insufficient menses, on the other hand, warm hip-baths of ten to fifteen minutes' duration are frequently useful, combined in some cases with the wet sheet-envelope; and dysmenorrhœa is likewise occasionally treated with advantage by the partial wet sheet-envelope.

This list of morbid conditions which may be more or less benefited, might easily be increased; and this is not astonishing if it is considered that hydrotherapeutic treatment can be infinitely modified and adapted to the powers of the constitution; and that it may be assisted by varying hygienic, climatic, dietetic, and pharmaceutical influences; for there does not exist any antagonism between hydrotherapeutic and other rational treatment, the former being, in fact, only part of the latter. Hence, however, it is also evident that the treatment in well-arranged hydrotherapeutic establishments ought to be under the guidance of the most intelligent physicians, just as is the case at all the best spas; indeed the physician at such an establishment ought to be of a very superior kind, possessing in a more than usual degree the gift of recognising all the individual peculiarities of the constitution, especially the amount of reacting power, adapting the principal remedy to every individual case, and combining other elements of treatment with hydrotherapeutic management wherever this is necessary. In the same way as we demand in suitable cases the administration of other remedies together with water-treatment in hydrotherapeutic establishments, so we must also express a wish, that out of such establishments, hydrotherapeutic elements should be more generally combined with the usual medical treatment. For this purpose it is to be desired that well-conducted establishments should be in or near large towns, in order that persons following their usual occupations might undergo certain kinds of treatment at such establishments, or that attendants from such establishments might be sent to the house of invalids. HERMANN WEBER.

HYDROTHORAX (ὕδωρ, water, and θώραξ, the chest).—Dropsy of the pleura. *See* PLEURA, Diseases of.

HYDRURIA (ὕδωρ, water, and οὖρον, urine). A profuse flow of watery urine. *See* URINE, Morbid Conditions of.

HYÈRES, in Var, France. Dry, warm climate. Town three miles from the sea. Much exposed to N.W. wind (*Mistral*) in spring. *See* CLIMATE, Treatment of Disease by.

HYGIENE (ὑγίεια, health).—The science and art relating to the preservation of health. *See* PERSONAL HEALTH; and PUBLIC HEALTH.

HYPÆMIA (ὑπὸ, under, and αἷμα, blood).—Deficiency of blood in a part; a synonym for local anæmia. *See* CIRCULATION, Disorders of.

HYPÆSTHESIA (ὑπὸ, under, and αἴσθησις, sensation).—Diminished sensibility of a part. *See* SENSATION, Disorders of.

HYPERÆMIA (ὑπὲρ, over or excessive, and αἷμα, blood),—Excess of blood in a part. *See* CIRCULATION, Disorders of.

HYPERÆSTHESIA (ὑπὲρ, over, and αἴσθησις, sensation).—Increased sensibility of a part, *See* SENSATION, Disorders of.

HYPERALGESIA (ὑπὲρ, over, and ἄλγος, pain).—Undue sensibility to painful impressions. *See* SENSATION, Disorders of.

HYPERIDROSIS (ὑπὲρ, excessive, and ἱδρῶς, sweat). — Excessive perspiration; also termed *idrosis*, *ephidrosis*, and *sudatoria*. *See* PERSPIRATION, Disorders of.

HYPERINOSIS (ὑπὲρ, over, and ἴς, ἰνός, flesh).—Excess of fibrin in the blood. *See* BLOOD, Morbid Conditions of.

HYPERMETROPIA (ὑπέρμετρος, beyond all measure, and ὤψ, the eye).—A congenital or acquired error of refraction of the eye, in which, owing to low refractive power of the dioptric media, or too little convexity of the refracting surfaces, or unnatural shortness of the anterio-posterior axis of the eyeball, parallel rays of light do not, while the accommodation is in repose, converge to a focus on the layer of rods and cones of the retina, as in the normal or emmetropic eye, but to an imaginary point somewhere behind. It is the opposite of Myopia, and is sometimes called Hyperopia or Hyperpresbyopia. *See* VISION, Disorders of.

HYPEROPIA (ὑπὲρ, above, and ὤψ, the eye). *See* HYPERMETROPIA.

HYPERPLASIA (ὑπὲρ, over, and πλάσσω, I mould or form).—An excessive growth of normal tissue-elements, which may lead to hypertrophy, or to the formation of distinct tumours. *See* HYPERTROPHY; and TUMOURS.

HYPERPRESBYOPIA (ὑπὲρ, above, πρέσβυς, old, and ὤψ, the eye). *See* HYPERMETROPIA.

HYPERPYREXIA (ὑπὲρ, excessive, and πυρεξία, fever).—Excessive pyrexia. *See* FEVER; and TEMPERATURE.

HYPERTROPHY (ὑπὲρ, over; and τροφὴ, nourishment).

DEFINITION.—The word 'hypertrophy' signifies excessive nourishment, but is in practice used to designate the result of excessive nourishment, that is, excessive growth. Hypertrophy may be *general* or *partial*.

I. **General Hypertrophy.**—General hypertrophy, though a remarkable condition, is of little practical importance. It is known only in those individuals of enormous size, who are called 'giants.' The production of giants depends on causes entirely unknown, since it is noticeable that this condition commonly affects only one in a family, and is in its most conspicuous forms not hereditary. Giants are usually of feeble constitution, and deficient in procreative power. The name *macrosomatia* has been given to a condition equally unexplained, in which the whole body becomes enlarged in a monstrous degree. This condition has been observed to be in some instances congenital, or, at least, to begin in very early life. True general hypertrophy does not appear to be capable of being produced by any artificial means, since excessive feeding either

produces hypertrophy almost confined to one tissue, namely, fat, or else fails to produce any enlargement at all.

II. **Partial Hypertrophy.**—By this is meant (*a*) excessive increase of any part of the body during the period of natural growth, either in intra-uterine or extra-uterine life; or (*b*) increase of a part already completely formed. According to this distinction hypertrophy may be classified as *congenital* or *acquired*.

1. Congenital Hypertrophy. — Congenital hypertrophy is that condition in which some part of the body begins from the first to grow so rapidly as to attain a size far beyond the normal. This condition has been seen to affect one side of the body, or one limb only, which thus becomes much larger than its fellow on the other side. Such a condition might be in theory difficult to distinguish from atrophy of the opposite side, or of the other limb, that is, from hemiatrophy (*see* Atrophy); but in general the hypertrophic side is so far beyond the normal size as to prevent ambiguity. One remarkable case is on record in which one leg and arm assumed the proportions of those of a giant, whilst the other remained unaltered. Sometimes a congenital hypertrophy occurs without this unilateral character, as in the case reported by Mr. Curling of a girl aged fifteen, who had several fingers of both hands enlarged in an extraordinary degree without any assignable cause, the equality of the two sides being nevertheless preserved. Such instances, although unexplained, must, it would seem, be put into the same class as the gigantic growth of the whole of the body. Hypertrophy of special tissues is also sometimes congenital, as of the skin in ichthyosis. Hypertrophies similar to those here called congenital may occur, though rarely, in adult life. The enlarged part is found to be highly vascular, to have an increased temperature, and to preserve its normal proportions. The cause is in these cases equally unknown.

2. Acquired Hypertrophy.—Acquired hypertrophies appear to result, roughly speaking, from the following causes:—(*a*) increased work; (*b*) pressure; (*c*) inflammation; (*d*) increased supplies of nourishment; or (*e*) physiological changes.

(*a*) *Increased work.*—Increased use of the part can produce hypertrophy only in those organs which have an active function, especially the muscles. It is a matter of familiar observation that voluntary muscles increase in size when much employed, as is seen in the often mentioned arm of the blacksmith or the leg of the ballet-dancer. In order to produce this increase, the exercise must be of a certain degree of intensity, but not excessive. It must be frequently repeated, with intervals of rest; and at the same time the nutrition of the whole body must be good. In the absence of these conditions, exercise is more likely to produce wasting. The explanation of this familiar process is still obscure.

Hypertrophy of the heart occurs in cases where that organ is made to work at a higher tension than the normal, and this higher tension can only result from increased resistance to the flow of blood, either at the orifice of the heart, or in the peripheral vessels. Hence the conditions most commonly giving rise to it are valvular disease, especially stenosis; and obstruction of the arteries, either by the thickening of their walls, or by contraction of their muscular coats. The right side of the heart will also become hypertrophied when any condition whatever hinders the passage of blood through the lungs. Disease of the kidneys is a frequent cause of enlargement of the left ventricle of the heart, though in what way is still a matter of discussion. It is only quite clear that the kidney-disease in some way increases the resistance in the smaller arteries and capillaries.

Hypertrophy of the smooth or involuntary muscular fibres also occurs whenever that tissue has to contract for a long period under a higher tension than the normal. Thus the walls of the bladder become thickened in cases where, from obstruction of the passages, the evacuation of urine is effected with more difficulty, and under a higher pressure, than usual. In the same way the walls of the stomach, the œsophagus, and intestines become hypertrophied in cases of obstruction to the passage of food through the alimentary canal.

The explanation commonly given of these cases of hypertrophy in the contractile organs is, that in consequence of obstruction the organ has to contract with greater force than usual, and thus becomes hypertrophied in the same manner as a voluntary muscle, which is frequently exercised. It is, however, clear that this so-called explanation does not account for the connection between obstruction and more powerful contraction. The only explanation that can be given is that in these cases pressure or tension on the organ itself is the stimulus to contraction, and that the force of contraction appears to depend roughly upon the strength of the tension which produces it.

There is less evidence that nervous or glandular structures undergo hypertrophy in consequence of their increased use; but if one kidney be destroyed the other is generally found enlarged; and some authorities believe in an increase in the size of the brain from mental activity.

(*b*) *Pressure.*— Pressure appears to produce hypertrophy only when it is moderate and intermittent. Excessive or continuous pressure rather produces atrophy. Thickening of the epidermis from external pressure is the most familiar instance. Pressure, perhaps, leads to hypertrophy by causing an increase of the flow of blood.

(*c*) *Inflammation.*—Inflammation when chronic is a cause of hypertrophy in some of the tissues, more especially in various forms of connective tissue. This is constantly the case in chronic interstitial inflammation of solid organs, in which indeed it is impossible to draw the line between inflammation and fibrous hypertrophy. But it should be remembered that this condition is usually accompanied by atrophy of the other tissues, so that the size of the organ itself is more likely to be diminished than increased. The serous membranes, as the pleura, peritoneum, and dura mater, become thickened from chronic or repeated inflammation. Thus periostitis is a frequent cause of hypertrophy of the bones. The skin also becomes thickened in chronic eczema, and this condition may

extend to the subcutaneous tissue. Acute inflammation, on the other hand, is more likely to produce wasting of the organ it affects.

(*d*) *Increased nourishment.*—It must be regarded as doubtful whether increased nourishment alone is capable of producing enlargement of any part of the body. It certainly does not necessarily do so, as is shown by the case of experimental hyperæmia. When this condition is produced, for instance, by section of the cervical sympathetic nerve, in one side of the face and head of an animal, hypertrophy is only a rare and occasional consequence. When, however, the increased supply of nutrition in the form of blood is combined with some irritation or functional stimulus, we often find hypertrophy result. Thus, for instance, reflex hyperæmia of the skin of the face or blushing, which is produced by numerous internal causes, such as gastric or uterine derangement, may subsist for years and reach a very high degree without altering the nutrition of the part. But if there should be in addition some disturbance or inflammation of the glands of the skin, we have the conditions called *acne rosacea*, &c., in which hypertrophy is an important element. Almost the only instance that can be quoted of hypertrophy from increase of blood-supply alone is that of the corpus luteum during pregnancy, when the ovary participates in the functional hyperæmia of the uterus. The well-known experiment of Hunter should also not be forgotten, in which he transplanted the spur of a cock from its foot to its head, and found it to increase in size.

It is, however, important to remember that hypertrophy, however produced, is always accompanied by an increased supply of blood, and enlargement of the vessels.

(*e*) *Physiological changes.* — Physiological hypertrophies form an important class. One of the best instances is that of the enlargement of the uterus during pregnancy. This enlargement is clearly not the consequence of hyperæmia alone, nor of increase of the functional activity in the muscular walls, though both these conditions are present; but must proceed from some direct physiological stimulus like that which determines the growth of the embryo itself. The hypertrophy affects all parts of the organ—its mucous and serous coats, as well as the muscular walls. Enlargement of the mammæ appears to arise from similar causes; and it is even probable that swelling of the thyroid may, through some obscure connection with the sexual organs, be caused in the same way. Some instances of hypertrophy we cannot in any way explain, such as the apparently spontaneous enlargement of the tonsils, spleen, and thymus gland, which are sometimes observed. The same is true of the enlargement of the prostate which is so common in old age. These changes have been sometimes explained by a supposed derangement of the so-called *trophic nerves*, but this explanation only puts the difficulty a little further back.

Process of Hypertrophy.—It has been a question whether hypertrophy depends upon the increase in the size of the minute elements of an organ, or only on increase of their number. There can be no doubt that the former change often occurs. Thus, in the pregnant uterus the muscular fibres have been found from seven to eleven times as long as natural, and from twice to seven times as wide. In a remarkable case of enlargement of the nerves, described by Dr. Moxon, the nerve-fibres were found to be on an average three times and some of them even forty times as large as normal. When enlargement of one kidney takes place as a consequence of destruction of the other, the tubules and Malpighian tufts are found greatly increased in size. In hypertrophy of the heart, the muscular bundles are found to be thickened, though the fibrillæ are unchanged; but in most cases multiplication of the tissue-elements is the chief cause of the increase in size. To this latter process Virchow gives the name of *hyperplasia*, and it is important to remember that, though constantly occurring in hypertrophy of organs, it does not necessarily lead to the latter change.

'False' Hypertrophy.—We sometimes have to distinguish between *true* and *false* hypertrophy, meaning by the latter a process in which an organ becomes outwardly increased in size, owing to the deposition within it of some foreign material, or to mere distension. Thus in a fatty liver the real liver-tissue is wasted, but is replaced by fat. An emphysematous lung appears to be increased in size, but has actually suffered atrophy. The substance of the brain in hydrocephalus may be greatly reduced in volume, though the head appears of enormous size. The very remarkable disease called 'Duchenne's Paralysis' is an instance of apparent hypertrophy of the muscles, through deposition of fat between the fibres. Finally, it should be remembered that hypertrophy is not necessarily a progressive or permanent condition, but may be only a stage in some chronic morbid process of which the termination is atrophy. This is very clearly seen in the process called 'fibroid degeneration,' elsewhere described.

Treatment.—No general rules can be laid down for the treatment of hypertrophy. When it is connected with increased functional activity, it is usually a favourable rather than a hurtful condition, though in some cases it may appear that the hypertrophy more than compensates the deficiency or irregularity by which it is produced. But even if this be so, the cure of excessive hypertrophy is not within our powers. Those forms of hypertrophy which are most likely to be injurious or fatal are unfortunately those of which the origin and conditions are most obscure, such, for instance, as enlargement of the prostate, the thyroid, or the spleen. The only hypertrophic condition which appears to be, generally speaking, amenable to treatment is that of fibrous thickening. Whenever the thickened fibrous tissue is accessible to direct treatment, we may probably be able to produce a beneficial effect by the application of counter-irritants, or by special stimulants, such as iodine. The administration of iodine or iodide of potassium internally also has a remarkable, and as yet unexplained effect in many such cases. It is, however, well to point out that when functional hypertrophy has resulted from some obstacle

or undue resistance, it may entirely subside when that resistance is removed. Thus if the uterus have enlarged around a fibrous tumour, it may regain its normal bulk when the tumour is removed; and we sometimes see a sensible diminution in the size of a hypertrophied heart when the derangements which produce it no longer act. Moreover, hypertrophy may be completely reduced by a general lowering of the nutrition of the body. Thus, in early stages of pulmonary phthisis, the heart may be hypertrophied, but when death occurs in a late period of the disease, the organ is rarely found enlarged, and is even wasted; though, according to Dr. Peacock's tables, less so than in other wasting diseases. J. F. PAYNE.

HYPINOSIS (*ὑπὸ*, under, and *ἴς, ἰνὸς*, flesh). Deficiency of fibrin in the blood. *See* BLOOD, Morbid Conditions of.

HYPNOTICS (*ὕπνος*, sleep).—Measures that induce sleep. *See* NARCOTICS.

HYPNOTISM (*ὕπνος*, sleep).—A synonym for Braidism. *See* BRAIDISM; and MESMERISM.

HYPOCHONDRIAC REGION (*ὑπὸ*, under, and *χόνδρος*, a cartilage).—This region is double, right and left, occupying the upper part of the abdomen on either side of the epigastrium, and partly corresponding to the lower regions of the chest, being almost entirely covered in by the ribs and their cartilages. Each hypochondrium is bounded below by a horizontal line at the level of the ninth costal cartilage; and internally by a vertical line from the eighth cartilage downwards. The organs situated in the right hypochondrium are the liver and gall-bladder mainly; with, more deeply, the pyloric end of the stomach, part of the duodenum, and the hepatic flexure of the colon. In the left region lie the spleen, a small portion of the left lobe of the liver, the fundus of the stomach, the tail of the pancreas, and the splenic flexure of the colon. The gastro-splenic fold of peritoneum, with its vessels, passes from the stomach to the spleen.

CLINICAL INVESTIGATION.—It must be borne in mind that morbid conditions within the chest not uncommonly originate clinical phenomena, both subjective and objective, in connection with one or other hypochondriac region, and these must always be taken into consideration when investigating any particular case. In making a diagnosis, no reliance whatever can be placed on mere sensations referred to these regions, but physical examination is in every instance required, in order to determine the conditions present, and especially palpation and percussion. Moreover, it must be remembered that disease of an important and serious nature may arise without the occurrence of any unusual feelings. Pain of various kinds is often complained of, and when referred to the right hypochondrium is usually supposed to be connected with the liver; but it may depend upon affections of the superficial structures; peritonitis; right pleurisy or pneumonia; or conditions associated with the pylorus, duodenum, or colon. A characteristic pain starting from this region is that of hepatic colic, usually due to the passage of a gall-stone. Persons who are hypochondriacal not uncommonly refer some abnormal sensation to their right hypochondrium, for which there is really no obvious cause. In the left hypochondrium pain may also be due to affections of the walls, or of structures within the thorax; of the cardiac end of the stomach; of the colon; or, in exceptional cases, of the spleen.

The morbid conditions which are capable of originating abnormal physical signs in the hypochondriac region may also be either thoracic or abdominal. Of the former, pleuritic effusion is the most frequent; and on the right side this condition may cause marked depression of the liver. In exceptional instances the heart is so enlarged as to reach the left hypochondrium; and the writer has met with a case in which a large thoracic aneurism presented in this region. As regards abdominal diseases in the right hypochondrium, abnormal physical signs are usually associated with the liver, which is altered in position, shape, size, or physical characters. Occasionally they are connected with the abdominal walls; the gall-bladder; or the stomach, duodenum, or colon. On the left side enlargement of the spleen is the main condition discovered by physical examination; but the stomach may also give signs of distension in this direction, or of organic disease of its walls. Exceptionally the colon may present abnormal physical signs. Growths may originate here in connection with the peritoneum, and the writer has recently had under observation a case in which a growth started from the left hypochondrium, probably of a malignant nature, and involving more than one structure, but it was impossible to say where it commenced. Of course the hypochondria are involved along with other regions in general enlargement of the abdomen; and organs from other regions may so increase in size in certain diseases as to extend into one or both of these regions.

FREDERICK T. ROBERTS.

HYPOCHONDRIASIS (*ὑπὸ*, under, and *χόνδρος*, a cartilage).—SYNON.: Fr. *Hypochondrie*; Ger. *Hypochondrie*.

DESCRIPTION.—The term hypochondriasis is derived from an ancient hypothesis that the symptoms of this disorder were due to perturbations of natural force generated in the liver and pylorus, to which idea the frequent prevalence of flatulence in the disorder conduced. The condition thus called is really a disease of the nervous system. It is a form of mental unsoundness closely allied to melancholia, of which, indeed, it often forms the initiatory stage. It is characterised by a morbid anxiety, either without any, or having only very slight foundations, relative to the state of physical health. The patient thinks about his health unduly, observing himself with restless care, examining especially the characteristics of his secretions, translating into evidence of progressive organic mischief every trivial departure from perfect action of his organs, and becoming more and more absorbed in precautions against the malady with which he believes himself affected. Nothing that happens tends to the side of reassurance. If his sleep be disturbed, the symptom may be portentous, he thinks, of brain-softening; if it be sound, the patient, instead of being comforted, fears apoplexy. Constipation of the bowels signifies

obstruction; a slight diarrhœa implies coming exhaustion. Everything which he reads or hears in reference to disease, the patient applies to his own case, examining himself on every point thus presented to his mind, and rarely failing to find something which dovetails with symptoms of his own. For he recognises only the points of resemblance; the features of difference are unconsciously ignored. In some cases the patient is constant in referring his troubles to one particular organ. Year after year his story is the same; it is his stomach, liver, brain, or some other organ which is in fault; but always the same. In other instances there is a vacillation quite as remarkable. Routed, perhaps, by the convincing arguments of his adviser, he is forced to yield the position which he had assumed, but only to take an equally strong one in reference to some other part of his frame. These diversities strongly recall the fixed and shifting delusions of insanity. He is prone to wander from one doctor to another, often carrying with him a bundle of prescriptions and a long written list of questions, which must receive categorical answers. Apparently satisfied at the time, he speedily recollects some point upon which he has not received assurance, and this he conceives vitiates the whole of the explanation and advice which have been given to him, and he is plunged again into his previous state of anxiety and doubt. Where circumstances do not involve forced labour for existence, the patient passes his time in chasing his health, which is always contriving to elude his grasp. If he holds an appointment, he will resign it in order to have full opportunity for studying himself, and his occupation once gone, he finds too late that it was his best friend, and he then ascribes to his forced idleness all the ills which had induced him to seek retirement.

In many cases the most careful examination can discover no signs of disease, and the patient wears the aspect of health; or there may be a worn, anxious look. In others there may be, especially in the digestive organs, slight deviations from perfect integrity, which explain some of the symptoms, but not the exaggerated apprehensions to which they give rise.

Hypochondriasis is a chronic disorder. It may continue, and this most frequently, as a harmless peculiarity attached to a life which is not perceptibly shortened in length, though often sadly diminished in utility and happiness, by its symptoms. Or there may be an improvement practically amounting to a cure, which will endure for a longer or shorter period. In the decline of life, however, there is very apt to be a return of symptoms. Or hypochondriasis may pass into true melancholia, and then the bodily health, previously the constant object of solicitude, improves wonderfully. Indeed, nothing more is heard about it.

Ætiology.—Hypochondriasis is very much more common in the male than the female sex. The period of life most prone to it is from 20 to 40 years of age. It is apt to occur in those who inherit a tendency to insanity, and the disease in its own peculiar form is often hereditary. Excesses of various kinds, especially on the side of the sexual system, will precipitate the appearance and intensify the symptoms of the affection, but it is doubtful whether they can altogether originate it. The same may be said of gout, which is apt to be associated with the condition and to complicate its symptoms. Depressing moral circumstances also are not without influence in determining an onset of hypochondriasis in those predisposed. This is especially true of mental strain. The frequent occurrence of some deviation from healthy condition in the liver, stomach, or bowels, which is noted in these cases, would suggest that, probably through an interruption to the perfect nutrition of the body, diseases of these viscera bear their part in the causation of hypochondriasis. The intercurrence of internal hæmorrhoids with bleeding is very common, and this would manifestly tend to keep up if it did not originate the disease. Stricture and chronic ulcer of the intestines are occasionally associations which probably also influence the appearance of hypochondriasis.

Anatomical Characters.—There are no anatomical characters peculiar to the disease.

Diagnosis.—When careful examination, which must never be omitted, has disproved the existence of organic disease tending to produce the symptoms described by the patient, it sometimes becomes a question whether the case be one of hypochondriasis or of melancholia.

In the former there is no tendency to suicide; on the contrary a strong desire to live pervades the sufferer's mind, and impels him to endless search for the cure of his ailments. He delights in consulting medical men and entering into the minutest details which he thinks can aid them in helping him. Up to a certain point his story is frequently characterised by a logical accuracy, which fails him, however, in some point of great importance, by which the conclusions are invalidated. The melancholic patient, on the other hand, is often suicidal and always despairs of any relief to his condition, the description of which as given by him is confused, frequently incoherent, and unintelligible.

Prognosis.—Early and marked hypochondriasis occurring in a person with a strong hereditary taint of insanity, without any definite cause of mental depression, is of ill omen. Such a case very often drifts into melancholia.

The prognosis is favourable, perhaps, the less strongly marked the hereditary predisposition and the more evident and adequate the immediate causes to which the patient has been exposed, the most potent of which are sexual or alcoholic excesses, mental strain or shock, or the sudden change from a life of activity to one of forced and, as the sequel shows, uncongenial leisure.

Treatment.—Moral treatment is also of any influence in a large majority of cases. Where there is, however, manifest anæmia, a history of syphilis, evidences of gouty mal-assimilation, accumulation of fæces, catarrh of the intestinal canal, or hæmorrhoids, the therapeutics proper to these conditions should be employed. Alcoholic stimulants should be avoided. Travel, especially under judicious companionship, and the encouragement of regular, definite, and useful employment for the attention and the physical powers, are the most potent means of treatment, by which the disease may be often much ame-

liorated, and sometimes cured. Ridicule of the patient's sufferings will rarely or never be of service, but at the same time a habit of prescribing for all the symptoms as they arise must be avoided. T. Buzzard.

HYPODERMIC INJECTION (ὑπὸ, under, and δέρμα, the skin).—The effective introduction of remedial agents into the system by subcutaneous injection was rarely possible until the discovery of the alkaloids enabled us to administer an active dose in very small bulk. Dr. Alexander Wood, of Edinburgh, undoubtedly deserves the credit of bringing this principle practically before the profession; and, improved as it has been by Mr. Hunter and others, the hypodermic method is now justly regarded as one of the most active and reliable of our therapeutic resources. It may be used in two essentially different ways.

I. The remedy is thrown into the *subcutaneous cellular tissue* by means of a sharp-pointed hollow needle, attached to a carefully graduated glass syringe. The little prick must be made as rapidly as possible, either by direct puncture, or in a more valvular direction, through a pinched-up fold of skin; and care must of course be taken to avoid the neighbourhood of all important structures. The solution employed must be small in quantity and bland in quality, and must be slowly introduced, as pain usually follows the too sudden or forcible depression of the piston; and we must satisfy ourselves before we begin to inject, that the point of the instrument has passed fairly through the skin, without imbedding itself in the substance of the muscles. When carefully performed, the advantages of this plan are great, for not only is it economical, drugs administered in this way acting much more powerfully than when given by the mouth; but absorption is very rapid, and the desired effect is swiftly and surely produced. The drawbacks of the hypodermic method are—the pain of puncture (which may be alleviated by a slight preliminary freezing of the skin); an occasional tendency to irritation and the formation of abscess; and, where morphia is concerned, the risks of nausea and syncope, and the dangers attending the not very remote possibility of acquiring opium-eating habits.

The principal drugs used hypodermically in this way are the following:—

1. *Morphia.*—Morphia thus administered forms by far our most effectual remedy for the relief of suffering. In all varieties of neuralgia, in the wearing agony of cancer and other incurable disorders, as well as in a host of painful and irritative affections, we derive invaluable aid from the use of the hypodermic syringe: remembering that the dose must at first be small, not exceeding $\frac{1}{6}$ of a grain, and that we derive no special advantage from injecting directly over the spot where the uncomfortable sensations are felt. Recollecting also the occasional occurrence of sickness and faintness, we shall do well to enforce the recumbent posture; to keep our patient under observation for a few minutes after the operation is over; and perhaps to combine $\frac{1}{100}$ grain of atropia, which seems to have in some measure the power of preventing the depressing action which morphia occasionally displays when administered alone.

2. *Atropia.*—Anstie had great faith in atropia, as the best of all remedies for pain in the pelvic viscera; and its injection hypodermically has been attended with good results in the nocturnal sweating of phthisis in doses of $\frac{1}{100}$ to $\frac{1}{50}$ grain; and also as an antidote in opium-poisoning, even up to half-a-grain.

3. *Ergotine.*—Ergotine acts most effectively in cases of hæmorrhage, its chief disadvantage being the development of black painful lumps at the site of puncture. The average dose is 2 grains.

4. *Quinine.*—This useful drug has been extensively used in tropical climates by hypodermic injection for ague, sunstroke, &c.; but the great pain attending the operation, and the subsequent liability to the formation of abscess, have proved effectual barriers to the general introduction of the practice into this country.

5. *Other drugs.*—Chloral, where subcutaneously used, also causes severe suffering, with the production of unhealthy ulcerations of the skin. Many persevering attempts have been made, but have not yet been successful in overcoming the very irritating effects of mercury when employed in this way. Out of the large number of other drugs, the subcutaneous use of which has been tried from time to time, we are unable to report any substantial advantage thus gained over their administration by the mouth.

II. The second hypodermic method is that recommended by Bartholow and various American and Continental physicians, and usually called the *deep* or *parenchymatous* method. This essentially consists in plunging the point of the needle into the muscles, and forcing the fluid freely among their fibres, and into the immediate neighbourhood of painful nerves. We are told that in this way chloroform is a very certain remedy for neuralgia; that strychnia is indicated in infantile, reflex, hysterical, and lead palsy; and that carbolic acid is useful in erysipelas. As yet, however, there is not much British experience to quote in confirmation of this practice.

In conclusion, we may note that most hypodermic solutions are readily destroyed by mould; and that Dr. Sansom has suggested a very handy series of gelatine disks, which will keep well in all climates, and which may readily be melted down when required for use.

Robert Farquharson.

HYPOGASTRIC REGION (ὑπὸ, under, and γαστὴρ, the belly).—The hypogastric region is conventionally described as lying between the right and left inguinal, below the umbilical, and above the pubic regions.

Anatomical Relations.—The *surface* of the hypogastric region in ordinary persons is flat, showing the muscular reliefs; it is rounded in children; and in some individuals, much emaciated from disease, it becomes concave.

The *median furrow* disappears below the umbilicus, owing to the approximation of the recti muscles.

The *integument* is very elastic and movable, especially at the sides.

The *superficial fascia* consists of two laminæ between which lie the subcutaneous vessels; but in the middle line these laminæ are blended. It

is strengthened at its lower part by the *triangular fascia.*

The *aponeuroses* of the external and internal oblique muscles are united in the linea alba, and form a portion of the *sheath of the rectus.*

The *recti muscles* themselves have their inferior attachments in this region, along the line extending between the spine and the symphysis of the pubes; their outer edges curve outwards, and become straight as they enter the sheaths.

The *pyramidales*, two small triangular muscles, arise from the pubes, lie in the same sheaths as the recti, and assist in closing in the abdominal parietes anteriorly and below.

Immediately beneath the recti is the *fascia transversalis*, with a little loose areolar tissue and fat, the fascia being tolerably adherent along the central line. Beneath the fascia transversalis there is a considerable amount of loose areolar tissue, between it and the *parietal peritoneum*, which in this region is very loosely attached, and reflected off the bladder on to the fascia transversalis. Enclosed in folds of the peritoneum lie, on either side, passing upwards to the umbilicus, the remains of the hypogastric arteries; and from the apex of the bladder in the middle line, passing to the umbilicus, is the obliterated urachus, which acts as the superior ligament of the bladder.

The *viscera* corresponding to the hypogastric region are:—the *bladder* when full; and the *small intestine*, covered by the *great omentum.* When the bladder is full, the intestines are pushed aside, and the former then lies against the pubes and recti. In children the bladder, being an abdominal rather than a pelvic viscus, always lies in this region. During pregnancy the *uterus* also corresponds with the hypogastric region.

The *vessels* are the deep epigastric, with the *veins* which pass obliquely inwards from the internal iliac. They lie between the peritoneum and the transversalis fascia.

The *nerves* are derived from the lower intercostals and lumbar. The *lymphatics* pass into the inguinal, superficial pubic, and lumbar glands.

Clinical Relations.—The hypogastric region is of clinical importance chiefly from an operative point of view. It is in the median furrow of this region that the operation of tapping in ascites is usually performed; and that the principal incision is made in ovariotomy, the Cæsarian section, and supra-pubic lithotomy. The bladder is occasionally tapped above the pubes. The presence of the distended bladder or of the pregnant uterus, forming a tumour in the hypogastrium, has been already referred to. Enlargements here from these causes have to be diagnosed from pelvic tumours of various kinds, which, in growing upwards into the abdomen, occasionally occupy the middle line instead of either groin. The only morbid condition of the abdominal parietes in the hypogastric region that requires special mention is abscess connected with disease of the lumbar spine, which occasionally points above the pubes, on either side of the middle line. The pus in such a case is situated between the peritoneum and the fascia transversalis.

Edward Bellamy.

HYPOGLOSSAL NERVE, Disorders of. The hypoglossal nerve is the motor nerve for the tongue, and for most of the other muscles which are attached to the hyoid bone, the exceptions being the stylo-hyoid, the mylo-hyoid, and the middle constrictor of the pharynx. It also supplies the sterno-thyroid muscle.

1. **Paralysis.**—Paralysis of this nerve is shown chiefly by the resulting interference with the movement of the tongue—'glossoplegia.'

Ætiology.—The nerve may be damaged in any part of its course by the growth of tumours; but is most commonly affected at its origin within the spinal canal, by pressure from tumours, meningitis, or syphilitic growths, or by caries of the upper cervical vertebræ. The tongue is also paralysed by disease of the nucleus of origin of the hypoglossal fibres, but its paralysis is then associated with that of the lips, and commonly also of the palate, pharynx, and glottis (*see* Labio-glosso-Laryngeal Paralysis). Disease of the motor tract above the nucleus also causes paralysis of the nerve, together with the face, arm, and leg of the same side. Bilateral glossoplegia commonly results from disease of the nucleus or its neighbourhood. Unilateral paralysis is due to disease of the motor tract above the nucleus, rarely of the nucleus itself, often of the fibres of the nerve within or outside the medulla.

Symptoms.—In unilateral paralysis, the tongue at rest is in its normal position in the mouth, but its root is higher up on the paralysed than on the normal side, in consequence of the loss of the tonic, or voluntary, contraction of the posterior fibres of the hyoglossus. Within the mouth the tongue is moved freely to the healthy side, but is not moved to the paralysed side. When protruded it deviates towards the paralysed side, because the protrusion is the result of the action of the fibres of the genio-glossus, and the tongue is pushed over towards the weaker side. In bilateral paralysis the tongue lies in the mouth behind the teeth, and cannot be protruded. If the loss of power is complete, the tongue cannot be projected over the lower teeth. It is broad and flabby, if there is no atrophy, and sometimes when atrophy is associated with fatty overgrowth. When there is much wasting, the part affected is shrunken and wrinkled. In unilateral paralysis, articulation and deglutition are little impaired. The pronunciation of labials, and the production of falsetto notes may, however, be difficult. In bilateral paralysis, articulation is impossible. Phonation is not impaired, unless the larynx is also paralysed. The mastication of food is impeded, because the food cannot be moved about the mouth. Deglutition is also interfered with, because the food cannot be rolled into the fauces; and soft foods, when they reach the pharynx, may be driven again into the mouth in consequence of the absence of the natural supporting movement of the tongue. Taste is not primarily affected, but may be somewhat dulled, because the patient is unable to move substances about the mouth.

Diagnosis.—The position of the lesion is indicated by the associations of the paralysis. If the disease is in the motor tract above the nucleus (pons, crus, or hemisphere), there is hemiplegic weakness on the side of the paralysis

of the tongue. In disease of the nucleus the paralysis is commonly bilateral, is associated with paralysis of the lips and throat, and there is usually wasting. Disease of the fibres of origin within the medulla is associated with paralysis of the opposite limbs, so that the tongue deviates from the paralysed side. When the disease is at the surface of the medulla, the paralysis is commonly unilateral, and is associated with paralysis of the corresponding half of the palate and vocal cord (Hughlings Jackson.) In disease of the fibres of origin within or outside the medulla, there is commonly wasting. The diagnosis of the pathological cause of the paralysis rests on the course of the affection, and on the presence of any causal and associated condition.

Prognosis.—This is usually unfavourable, on account of the gravity of the disease which damages the nerve or centre. Even in syphilitic cases, recovery is often incomplete.

Treatment.—The treatment of paralysis of the hypoglossal nerve is that of the causal disease. Tonics, counter-irritation, iodide of potassium and mercury, with occasionally the application of electricity to the tongue, are the most important remedies to be employed, according to the ætiological indication. The most convenient method of applying electricity is by means of a tongue depressor in a wooden handle, the blade being insulated by a coating of sealing wax where it comes in contact with the lips.

2. Spasm.—Spasm in the parts supplied by the hypoglossal nerve is rare. The tongue participates in the convulsive movements in epilepsy, is jerked between the champing jaws, and thus becomes bitten. Cases have been met with in which the tongue is affected with a 'functional spasm' in speaking, analogous to 'writer's cramp,' but these are so rare as scarcely to need detailed description. W. R. Gowers.

HYPOSPADIAS (*ὑπὸ*, under, and *σπάδιον*, a space).—A malformation of the penis in which the orifice of the urethra is underneath or behind the glans. *See* Malformations.

HYPOSTASIS (*ὑπὸ*, under, and *στάω*, I stand).—Definition.—This term is applied to that condition of the vessels of a part, which consists in an overfulness, caused mainly by a dependent position, with a varying degree of diminution in the rate of flow of the contained fluid.

Pathology.—The entire conditions of the venous circulation are such as to readily favour a stasis or stagnation of the blood-flow; and a trifling cause, such as would in no way affect the arterial flow, may easily impede the venous current. The veins also are, as a rule, less firmly supported by the surrounding tissues than the arteries; and this, with their thinner coats, slighter elasticity and resistance, render them easily liable to distension by the blood in congestion. If a dependent position be added to these conditions, thereby offering a resistance to the return flow of the blood, whilst it favours the circulation in the arteries, a combination of circumstances exists to which the term *hypostatic congestion* is applied. The liability of the veins of the leg to become congested, leading to a varicose condition and its results, is an example of this state. If, in addition to all these factors, the heart be enfeebled and the arterial tone be diminished, obviously another cause for stagnation is introduced, and of necessity will manifest itself most in those situations predisposed to stasis. Such a state is seen in the hypostatic congestion of the lungs, which usually attends in a greater or less degree all pyrexial conditions. The recumbent attitude, the enfeebled art, and the lax vessels eminently favour an overfulness of the veins. It is obvious that although the excess of blood primarily occurs on the venous side of the capillary system, very soon the arterial area will share in the engorgement, and the whole vascular system of the part become overfilled.

Results.—The pathological results of such a state are very much the same as those following any congestion. The distended vessels, with the increased blood-pressure that co-exists, readily permit of a transudation of the fluid part of the blood, hence œdema; if the conditions be extreme, capillary rupture may take place, and hæmorrhagic effusions result. Any continuance of this state will lead to malnutrition of the tissues affected; the proper supply of arterial blood is interfered with; and the part is loaded with an effete venous blood, and infiltrated with serum. Hence the structural repair of the tissues is improperly performed, and there is a tendency to the development of an imperfect form of connective tissue; or, on the other hand, the destructive rather than the productive aspect may predominate, and ulceration follow. When the hypostasis is associated with an acute general state, as of the lungs in any specific febrile disease, it is very apt to pass on into a form of inflammation characterised by a want of acuteness. There are the same inflammatory products, the same changes in the vessels and tissues of the lungs, and very much the same symptoms as occur in the course of an ordinary pneumonia, but they are less severe in character, and on the whole do not tend so readily to a favourable resolution.

Treatment.—Recognising the cause, alteration of position is obviously the rational treatment of hypostatic congestion; additional support by bandaging is often advisable. In acute febrile diseases stimulants are of much service in the prevention or relief of this condition in connection with the lungs, should the heart's action be enfeebled. W. H. Allchin.

HYSTERALGIA (*ὑστέρα*, the womb, and *ἄλγος*, pain).—Pain in the womb, frequently supposed to be of a neuralgic nature. *See* Womb, Diseases of.

HYSTERIA (*ὑστέρα*, the womb).—Synon.: Fr. *Hystérie*; Ger. *Hysterie*.

Hysteria is a term the etymology of which is misleading, and had best, therefore, be disregarded. It is often improperly applied to cases of simple malingering, and others which do not admit of ready explanation. Its use is best restricted to a condition of the nervous system fairly defined, but the intimate pathology of which is not known, characterised by the occurrence of convulsive seizures and by departures from normal function of various organs, leading to very numerous and

often perplexing symptoms. These are apt to simulate those commonly arising from definite alterations of structure, but differ from the latter in the fact that they may often, even when at their worst, be removed instantaneously, usually under the influence of strong emotion. It would seem that there is a disturbed or congenitally defective condition of the cerebral substance, involving in all cases the highest nervous centres, and in various examples extending more or less also to some of those which preside over automatic phenomena. Partial or complete suspension of inhibitory influence would appear to be the most patent result of the condition, whatever it be, and this is recognised as well in regard to the mental as to the more evidently physical processes belonging to cerebral function. A laugh which cannot be checked, but continues until tears flow, or the limbs become convulsed, is a typical example of such a suspension of control, and, if studied, throws light upon the nature of a considerable portion of the phenomena of hysteria. The jerking expirations of laughter arise from excitation of the respiratory centre, and when this excitation, uncontrolled by higher centres, acquires an abnormal strength, it extends to other parts of the medulla oblongata and spinal cord, and produces general convulsions. It overflows, as it were, into other nervous centres which in health would receive none of the exciting impulse. Between the lowest (automatic) functions of the cerebro-spinal nervous system and the highest (psychical) there is an ever-increasingly complex system of excito-motor processes, which may be in part or wholly under the pathological influence, whatever it be. Hence the *bizarre* character of the hysterical phenomena, and the circumstance that the symptoms always include modifications of those processes which underlie the mental faculties. The suspension of the power of control possessed by the higher centres explains the irregular movements, spasms, and convulsions. Hyperæsthesia and pain are dependent, probably, in hysteria, upon such a molecular change being initiated in the sensory ganglionic centres as is ordinarily propagated from the periphery. Hysterical paralysis, on the other hand, signifies that the power of the higher centres in liberating movements is in abeyance. In hysterical anæsthesia it is probably feeling or sensory perception and not the function of the sensory apparatus which is in abeyance, whilst the reflex actions which result from excitation of sensory nerves are performed in an orderly manner. A patient may work a needle with fingers which can be touched or pricked without the act being felt. Tactile impressions are conveyed to the ganglionic centres by the afferent nerves, and excite the action of efferent nerves so that the muscles are contracted. What is wanting is the participation of those higher centres in which consciousness runs parallel to this physiological action.

Ætiology.—*Predisposing causes.*—A state of more or less imperfect development of the higher nervous centres of congenital origin very frequently underlies, it is probable, the various circumstances which apparently conduce to the hysterical conditions.

The female sex is much more prone than the male to the affection, which usually occurs between the ages of fifteen and thirty, and most frequently of all between fifteen and twenty. Luxury, ill-directed education, and unhappy surroundings, celibacy where not of choice but enforced by circumstances, unfortunate marriages, alcoholism, premature cessation of ovulation, and long-continued trouble—all predispose to hysteria. A somewhat frequent antecedent is a long and wearisome nursing of a sick relation, with much broken rest. The disorder is only exceptionally found in women suffering from diseases of the genital organs, and its relation to uterine and ovarian disturbance is probably neither more nor less than that which obtains in other neuroses. Exception must be made in the case of prostitutes affected with venereal disorders, who are very prone to hysteria. In this class, however, the condition is complicated by the physical and moral influences to which their life subjects them, and amongst these alcohol frequently occupies a very important place. Like epilepsy, migraine, and some forms of insanity, hysteria is prone to be intensified at the catamenial period.

The occurrence of hysteria (although comparatively rare) in males is sufficient of itself to disprove the uterine theory of causation.

Determining causes.—These include painful impressions; long fasting; strong emotions; imitation; and shock to the nervous system, physical or moral.

Symptoms and Diagnosis.—In the limited space in which it is necessary that the subject of hysteria should be treated, it will be best to describe together some of the most frequent forms which the neurosis takes, and the principles upon which a diagnosis can be made. Hysteria produces symptoms which may be referred to every function of the body. For consideration they may be roughly classed in the following groups, it being understood that all may occur either coincidently or in succession:—1. *Mental.* 2. *Sensory.* 3. *Motor.* 4. *Circulatory.* 5. *Visceral.*

1. *Mental.*—The intelligence may be apparently of good quality, the patient evincing sometimes remarkable quickness of apprehension; but, carefully tested, it is found to be wanting in the essentials of the highest class of mental power. The memory may be good, but judgment is weak, and the ability to concentrate the attention for any length of time upon a subject is absent. So also regard for accuracy, and the energy necessary to ensure it in any work that is undertaken, are deficient. The emotions are excited with undue readiness, and when aroused are incapable of control. Tears are occasioned not only by pathetic ideas but by ridiculous subjects, and peals of laughter may incongruously greet some tragic announcement. Or the converse may take place; the ordinary signs of emotion may be absent, and replaced by an attack of coma, convulsion, pain, or paralysis. Perhaps more constant than any other phenomena in hysteria is a pronounced desire for the sympathy and interest of others. This is evidently only one of the most characteristic qualities of femininity uncontrolled by the action of the higher nervous centres, which in a healthy state keep it in subjection. There is very frequently not only a deficient regard for

truthfulness, but a proneness to active deception and dishonesty. So common is this, that the various phases of hysteria are often assumed to be simple examples of voluntary simulation, and the title of disease refused to the condition. But it seems more reasonable to refer the symptom to impairment of the highly complex nervous processes which form the physiological side of the moral faculties.

2. *Sensory.*—Pain, hyperæsthesia, and anæsthesia occur with perhaps equal frequency. The diagnosis of the hysterical origin of such alterations of sensibility is effected partly by excluding the presence of other causes, and partly by consideration of any accompanying or antecedent peculiarities of manner and conduct. Hysterical *pain*, where it is associated with some evident local change, is found to be greatly in excess of that which would ordinarily accompany the observed cause. Where pain or hyperæsthesia is complained of in situations and of a character which would commonly point to some existing inflammation, it is necessary, by examination of the pulse and temperature, to exclude such a condition. Hysterical pain is apt to cease suddenly when the attention is diverted, and to be increased by inquiry and sympathy. Some of the most common seats of pain and tenderness are the following:—

(*a*) The lower part of the side of the chest (usually the left) simulating intercostal neuralgia, but distinguished from it by the tenderness being wide-spread, superficial, and not confined to certain points. Pressure here will sometimes occasion disturbances of respiration and circulation.

(*b*) Some of the vertebral spines, usually in the cervical and upper dorsal region. From the error of mistaking this for commencing disease of the vertebræ numbers of young women have been confined to a couch for months or years, and their health permanently damaged. The points of diagnosis are the patient's antecedents; there is often a history of aphonia, or paralysis, or hysterical fits. Or it may happen that, long after the pain has been first complained of, the patient has been seen to take a prodigious amount of exercise *on some one occasion* without complaint. A very much slighter pressure, too, causes pain than is at all usual in vertebral caries. It has to be remembered, however, that a patient affected with vertebral disease may also be hysterical.

(*c*) Acute pain in a joint, occurring usually some little time after a slight injury and giving rise to suspicion of inflammation, but distinguished from this by the fact that after a few days of great pain the joint does not feel hot to the touch, and is not swollen, and that the thermometer shows no rise of temperature. The pain is more easily excited, too, by touching the skin than by pressing the articulatory surfaces against each other.

It is necessary to remember that in locomotor ataxy there may be exquisite pains (of a shooting character) having their seat in a joint or its neighbourhood, and accompanied by some localised hyperæsthesia of the skin. The disease rarely affects young females, but it may do so, and the condition is then extremely liable to be mistaken for hysteria. The chief points of diagnosis are, that in locomotor ataxy there will be—1. absence of patellar tendon reflex; 2. a peculiar character of the pains—lightning-like; 3. probably some analgesia of the extremities; and 4. an ataxic gait. *See* Locomotor Ataxy.

(*d*) Tenderness of the mamma or darting pains through its substance, recalling those of scirrhus. The absence of any lump, and the effect of engaging attention, will serve to distinguish.

(*e*) Pain in the head of very severe character, 'like a nail being driven into the skull' (*clavus*). This is probably neuralgic, and is by no means confined to the hysterical. There is also a more diffused pain, described as of great violence and exceedingly obstinate. This pain is sometimes suggestive of cerebral tumour, from which, however, it may often be distinguished by the fact that the ophthalmoscope shows no optic neuritis, and that there is no vomiting. But great caution is necessary in coming to a conclusion that severe and long-continued pain in the head is hysterical. And here it may be well to say that in an accurate knowledge of the characteristics of the disease supposed to be simulated lies the only safety as regards diagnosis. Nor must it be forgotten that persons with serious organic disease are frequently affected also with hysterical symptoms.

(*f*) Epigastric tenderness. Careful pressure will often show that the tenderness is at the origin of the recto-abdominalis muscles, and not in the stomach. But there is sometimes pain in the stomach itself, and this may be associated with disgust for food or depraved appetite.

(*g*) Tenderness in one or other iliac region, deep pressure upon which will sometimes evolve hysterical symptoms, and also in some cases of hysterical convulsions will check the paroxysm.

Anæsthesia may involve (though rarely) the whole body. It is more commonly confined to one half, and this the left, and is then frequently associated with tenderness in the iliac region of the same side; or it may be limited to a small patch. The sense of touch often remains whilst painful impressions and those of temperature cannot be perceived. The anæsthesia may be confined to the surface, or involve as well the deeper structures, into which pins may be stuck without evoking signs of pain. The left conjunctiva is often the seat of anæsthesia, so that it may be touched or even rubbed without any reflex movements of the eyelids being excited. So also the pharynx may be tickled without exciting the ordinary spasmodic contraction, and the epiglottis touched by the finger without inconvenience. Such affections of cutaneous sensibility may have to be looked for, as they are often unsuspected by the patient herself. As regards diagnosis the existence of peripheral nerve-lesions may be excluded, by the absence of trophic disturbance. The condition is not likely to be confounded with hemiplegia, unless perhaps when it has immediately followed a convulsive attack, and is accompanied by apparent loss of power in the limbs. Examination of the patient and her history will suffice for the diagnosis. The other special senses also may be disordered in hysteria. There may be intolerance of light, subjective sense of taste or smell, roaring noises

in the ears; or, conversely, loss of sight (either in half of both eyes, or in one eye), loss of smell, or taste, or hearing. Or there may be feelings as of a limb or other part being enormously enlarged, of the body being confined in a stiff case, of the feet being drawn up by strings under them, of 'pins and needles' around the waist, or of numbness and coldness in one half of the body (almost always the left). It may be said generally of the disorders of sensation that they are capricious in their appearance, coming and going, as they would not did they depend upon organic disease (this recurrence is especially significant); that they are very apt to ensue upon some moral shock or convulsive seizure; and that careful examination will prove them to be unaccompanied by such other symptoms as would be likely to be present did they depend upon the organic alteration which they simulate.

3. *Motor.*—The principal motor symptoms in hysteria are local spasm, more or less general convulsion, and paralysis. The most common of all symptoms of hysteria is the *globus hystericus*. A lump appears to the patient to arise from the epigastrium like an egg, and, travelling upwards to the throat, causes a sensation of choking, and is often accompanied by an outburst of tears.

Spasm affecting some out of the various muscles concerned in the respiratory acts gives rise to a great variety of symptoms highly characteristic of hysteria. There may be cough of a peculiarly sharp, ringing character, constant except during sleep, unaccompanied by expectoration, strongly influenced by moral causes. A little observation will show that the cough does not occur when the patient is quite alone and apparently no one within earshot, but, on the other hand, it is greatly intensified by enquiry and solicitude. It ceases during sleep. Sometimes, instead of cough, a loud expiratory sound is produced, of most discordant character, resembling, perhaps, a railway whistle, the quacking of a duck, or the barking of a dog; and this may take place irregularly, or may be marked by a curiously distinct periodicity. Or there may be rapid, deep whooping inspirations, with signs of suffocation. Occasionally with the hysterical cough there is a hypersecretion of mucus; and if, as often happens, there is also disturbance of digestive functions and consequent tendency to emaciation, and at the same time such constriction of the air-passages as gives rise to sibilant *râles*, a *primâ facie* resemblance to phthisis is presented, which can only be distinguished by prolonged observation, aided by the stethoscope and thermometer. Laughing and crying are very frequent forms of expiratory spasm. Yawning, hiccough, and sneezing are also met with. *Clonic spasm* of muscles, especially of those moving the head and shoulders, or back, is not uncommon. Or one of the muscles of the thigh may be so affected, and the apparent pulsation caused by the rhythmical contractions give rise to a suspicion of aneurism.

Tonic spasm of one or more muscles of a limb is still more frequent. It is often very obstinate, and after enduring for months or years may suddenly resolve without any permanent alteration being left behind.

Contraction of a limb thus produced may continue during sleep and even resist the influence of chloroform inhalation, unless this is pushed to its full extent. Should one of the abdominal muscles be thus affected, an abdominal tumour is produced, which may be mistaken for some growth in the cavity; and if the pulsations of the aorta should be communicated to it, a strong *primâ facie* resemblance to abdominal aneurism is caused. The best mode of diagnosis is by faradisation, which, if persevered in for several minutes, will exhaust the muscular contractility and cure the ailment if it be of this kind. If it is not a 'phantom tumour' of this description but a genuine growth, the muscle will be contracted by the current, and it may then be possible to feel the tumour as something evidently distinct from the muscle.

Convulsive seizures are of common occurrence, and are usually preceded by a sense of suffocation, difficulty of swallowing, pain in the belly or stomach, headache, vertigo, or some indescribable sensation in one of the extremities. There is often a cry as of one being choked, unlike the peculiar wailing shriek which ushers in the epileptic seizure. Usually there is not the extreme suddenness of attack which characterises epilepsy, but the patient may be manifestly struggling against the seizure for a small but appreciable interval. When at last she falls, she does not usually do so with violence enough to receive severe injury, and positions of danger are generally avoided. The epileptic often falls in the fire, the hysterical patient never. The spasms of muscles which succeed are often tetanic in character, and sometimes wear an aspect of design—the patient grips articles with her hands or teeth. The face may be more or less red. In epilepsy it is usually first pale and then livid.

There is often more or less complete opisthotonos, which is usually absent in epilepsy. It is doubtful how far consciousness is ever completely lost, but though for the most part it is retained during the attack, there are certainly cases in which it is to a great extent in abeyance. It is characteristic of hysteria that, however rapid and violent the contortions, the patient usually avoids inflicting any serious injury upon herself. During the attack gesticulations and language are apt to be used which may be reproachful, or marked by an amatory character as regards some bystander, such as is calculated to cause embarrassment. There may be a single convulsive seizure, terminated by a fit of weeping and the passage of a large quantity of almost colourless urine of low specific gravity. Or there may be a succession of attacks extending sometimes over several hours. The tongue is not bitten. As a rule the hysterical patient rapidly returns to her ordinary condition after the outburst is completed, and fails to show the heaviness and tendency to sleep which is characteristic of epilepsy. The variety seen in the character of hysterical convulsions suggests that the pathological influence involves the nervous centres, sometimes more and sometimes less extensively; showing every degree of muscular movements, from those of a highly co-ordinated or quasi-voluntary kind, down to those of a simply tetanic form, such as appear to indicate either that control of the reflex function of the spinal cord is temporarily suspended, or that the cerebellar influence, as Hughlings

Jackson thinks, is being allowed to have full play, owing to some peculiar condition of the cerebrum interfering for a time with its normal power of antagonism. But it must be borne in mind that the hysterical patient may, like others, become epileptic, and that there is nothing to prevent the chronic epileptic betraying occasionally symptoms of hysteria. Such mixed cases are often difficult of diagnosis, and it is usually only a prolonged observation which succeeds in distinguishing the nature of the condition. Movements which somewhat resemble those of chorea are occasionally met with, but their character and the surrounding circumstances usually make it easy to distinguish them.

Paralysis may affect any of the limbs in hysteria, but paraplegia is the more usual form. Hemiplegia is comparatively rare. The muscles retain their nutrition. There is often at first a slight loss of irritability to induced currents, but after a very few applications this becomes normal. At first, too, considerable electro-cutaneous and electro-muscular insensibility may be present. If the form of paralysis be hemiplegic, the mouth is not affected; if paraplegic, the sphincters are not paralysed, and there is never any bedsore. If the arm be the limb affected, and the examiner, after flexing it slightly leaves go, it will sometimes remain in the flexed position, which it would not do in hemiplegia. It is noteworthy that in half the cases of hysterical paralysis, there is no history of antecedent convulsions. Cutaneous anæsthesia of the extremities will give rise sometimes to a pseudo-paralysis, and muscular anæsthesia may cause symptoms of ataxy. These may be distinguished from the result of organic change by careful examination. Hysterical speechlessness may be distinguished from aphasia by the patient being able to write down with great facility the wishes she is unable to express in speech; and from localised paralysis of the tongue, by her being perfectly able to swallow.

4. *Circulatory.*—There may be syncope which will simulate dying. After an indescribable sensation at the heart—a fulness or stifling feeling—the pulse becomes almost imperceptible, the patient is speechless, and, for periods varying in length, is apparently in a most precarious condition, recovery taking place after prolonged sighing. Or there may be tumultuous action of the heart. The abdominal aorta (and sometimes also other arteries) is occasionally the seat of powerful pulsations, which are visible in their effects upon the abdominal wall and strongly suggest the existence of aneurism. The capillary circulation may be deranged in the two directions of hyperæmia and ischæmia. In the former there is a patch of redness of the skin accompanied by a feeling of burning and tenderness; in the latter, which is especially seen in conjunction with analgesia, the skin is pale and no bleeding follows the pricks of a pin. In a recorded case, pressure upon a tender spinous process checked the radial pulse for a time.

5. *Visceral.*—Vomiting is sometimes a very obstinate symptom, all food taken being speedily ejected, the condition lasting a surprisingly long time, often for many months, without usually so much prostration as might be expected, but nevertheless with great loss of weight. Or there may be such an active aversion from food as renders it very difficult to support nutrition; or a depraved appetite may cause substances to be swallowed which have no nutritious property. In the belly there is frequently a hyper-secretion of gas with spasm of the bowels, causing borborygmi and noisy eructations. Intestinal gas may be imprisoned between two points of spasmodic contraction of the intestine, giving origin to a tumour capable of being moved about in the abdominal cavity, and of sudden resolution. These balloons, it is probable, are sometimes mistaken for tumours of the spleen, kidney, or other organ. It is not uncommon to have retention of urine, the bladder becoming greatly distended, but contracting at once and expelling its contents if the patient be placed in a hip-bath, and a bucket of cold water be thrown over the pelvis. In other cases there is an unduly frequent desire to empty the bladder. The secretion of urine may be suppressed almost entirely (but this is very rare), the little urine that is passed containing an unusual proportion of urea, which is also found in the vomiting accompanying this condition.

There is sometimes very obstinate constipation, giving rise to enormous impaction of fæces—occasionally also diarrhœa.

Cases occur in which the symptoms of cerebro-spinal sclerosis of the disseminated form, after persisting perhaps for many months in a young woman, rapidly or even suddenly disappear. The close resemblance to a disease which is not only incurable but tends to become progressively worse, is so strong that it is often impossible to form a diagnosis, and a very guarded prognosis becomes necessary. In the present state of our knowledge it is customary to class such cases with those of hysterical paralysis; but it is quite a question whether they are not really cases of incipient cerebro-spinal sclerosis, recovering ere the stage of irreparable change is arrived at. There is good reason to think that cases of disseminated cerebro-spinal sclerosis are not at all unfrequently supposed to be simple examples of hysteria. The disease is characterised in its early stage (the only period when mistake is possible) by some general weakness of limbs, accompanied by slight tremors on voluntary movement only, and an utterance which is slow and drawling, with occasional slurring of words. Careful examination, especially noting the circumstance that, for example, the arm only shakes when the patient is directed to take hold of an object, is usually sufficient to distinguish the disease from hysteria, but there is sometimes considerable difficulty, and caution should be observed in avoiding hasty conclusions.

Sequelæ.—Hysterical symptoms sometimes pass into those of mania, melancholia, and occasionally also of dementia.

Prognosis.—This is favourable as regards life, death from hysteria being very rare. Recovery for a time is common enough, but too often there is a return of the disease, the symptoms being usually of a different kind. Some patients will run through almost every conceivable phase of the disorder in turn. As a rule there is a tendency to cessation of the disease after the climacteric period. It occasionally happens, however,

that the disease is continued into an advanced period of life.

Treatment.—If Medicine were in a position to regulate the mode of life, food, education, and especially the selections for propagation of the species, it is probable that in succeeding generations hysteria would become more and more rare in the race. It can do, however, but little for the individual. Intercurrent maladies must of course receive the treatment proper to them. Where anæmia is present much good may often be done by iron. States of malnutrition tend to precipitate and intensify hysterical symptoms; and to remedy these is often to do much for the concomitant nervous disorder.

But probably the greatest amount of benefit which can be brought to bear upon the hysterical patient is through her surroundings. A girl who has not spoken above a whisper for months whilst at home, will often recover her natural tone of voice in a week if placed under the judicious discipline of strangers. This is a well-known circumstance, and the fact has tended very much to the belief that hysteria is simply vicious simulation. Such an inference is unjust.

That an altered relation of the ganglionic nerve-cells to the blood-supply forms at least a part of the pathology of hysteria appears probable from the effects of fasting in provoking hysterical outbursts, and the influence of food and stimulants in postponing them. Ammonia inhaled by the nostrils is a well-known and valuable agent for the purpose. Alcohol should be avoided altogether, as there is great danger of excess.

It is through the sensory nerves that the most rapid influence is brought to bear upon the hysterical condition. Thus cutaneous anæsthesia and hyperæsthesia may often be rapidly cured by the application of strong induced currents to the portion of skin; aphonia by acting in a similar way upon the skin covering the larnyx. Paralysis of the limbs is in many cases quickly cured by the same means.

Hysterical convulsions may almost always be cut short by douching the patient very freely indeed with cold water. This should be poured from a height upon the face. For a few seconds there is no perceptible effect, then the breathing becomes gasping, and the patient seeks by moving away to avoid any further application. It often happens that the remembrance of this treatment serves to prevent a repetition of convulsions, but it would be wrong to conclude from this that the proceedings of the patient had been voluntary. The effect of the cold douche is to create, through the medium of the cutaneous nerves, a sudden change in the character of the blood-circulation, which may well influence the state of the ganglionic nerve-centres. The supposition seems fair that to remember the shock is to have a weak excitement of the nerve-centres which were strongly excited by the application.

Bromide of potassium, which is of such value in the *grand mal* of epilepsy, has no influence in preventing hysterical convulsions. In a doubtful case the exhibition of this drug is therefore useful for purposes of diagnosis. Valerian (the powder or tincture) has an unquestionable effect in the convulsive and spasmodic symptoms of hysteria, little or none probably upon the paralytic phases. Assafœtida by enema is useful in tympanites and colic of hysterical origin. Small doses of strychnia and opium are useful in relieving some of the distressing feelings complained of by hysterical patients.

It is often a question whether the hysterical should marry. Where the disorder is slight and the general health is good, marriage may be advised, supposing that the prospects of a happy union are favourable. But in very severe cases, and especially when there is also a strong neurotic history in the family, it should be discountenanced. Nothing but harm can be expected from the strain of domestic cares upon a congenitally defective nervous system. T. Buzzard.

HYSTERICAL INSANITY. — Almost every variety of insanity may present in certain patients features which are commonly known and termed 'hysterical.' Melancholic individuals will be afflicted with hysterical paraplegia or other paralyses. Some will become cataleptic or apparently unconscious, others will display all the phenomena of hystero-epilepsy. Not unfrequently do we see a violent outburst of acute mania culminating and subsiding in a brief period of time, resembling in this an ordinary attack of 'hysterics.' It may be doubtful, however, whether hysterical insanity should be looked upon as a special variety of the malady. It seems more correct to look upon it as insanity occurring in hysterical patients, and characterised by the phenomena peculiar to them. We may expect sudden changes of symptoms, sudden improvements, and sudden relapses.

Prognosis.—The prognosis is unfavourable, as this insanity is found in patients of an unstable nervous organization, prone to frequent derangement. Even if recovery takes place, subsequent attacks are not unlikely to occur.

Treatment.—Such persons require above all others moral treatment. Medical treatment should be directed towards the improvement of the general health rather than the removal of special symptoms. G. F. Blandford.

HYSTERITIS (*ὑστέρα*, the womb).—Inflammation of the womb. *See* Womb, Diseases of.

HYSTERO-EPILEPSY.—Synon.: Fr. *Hystéro-Épilepsie*; *Hystérie épileptiforme*; Ger. *Hysteroepilepsie*.

Definition.—A term applied to a form of hysteria of unusual gravity, the convulsions in their violence recalling those of epilepsy, and characterised by the occurrence of remarkable forms of anæsthesia, paralysis, and contraction of muscles.

Ætiology.—The condition is one which must be classed with hysteria, and not with epilepsy, and the circumstances which tend to the production of the former disease are here equally potent. *See* Hysteria.

Symptoms and Diagnosis.—It is to the French school, and especially to Professor Charcot of Paris, that we owe the most important descriptions of this disease, which would appear to be more common on the Continent than in England. The symptoms may be divided into:—1. *Motor*; and 2. *Sensory*.

1. *Motor*.—Convulsive seizures occur, preceded

by an hysterical aura (abdominal or epigastric), which usually gives the patient timely warning enough to enable her to place herself in a position of safety. Then there is a shriek, the face is pallid, and she falls (perhaps whilst endeavouring to quit the room), the features become distorted, and the limbs pass into a state of tonic rigidity. There is foaming at the mouth, sometimes the tongue is bitten, and there may be some clonic convulsions with lividity of features. Relaxation of the muscles and a more or less comatose condition succeed, to be followed shortly, however, by contortions and gesticulations of a violent character, coarsely suggestive of the influence of various passions—wrath, fear, disgust, lust. Or there may be meaningless writhings, presenting a hideous aspect. To this phase sometimes succeeds hallucination of vision, or of hearing. Rats and serpents and other objects of horror are seen. The attack ends with sobs or hysterical laughter. There may remain a temporary inability to empty the bladder or to swallow food.

Convulsive seizures of this co-ordinated or purposive character, although much more common in the female than the male sex, are by no means confined to the former. The condition is not unfrequently observed in boys, less often in men. In the latter there is usually the history of some great moral shock antecedent to the first outbreak.

In patients liable to attacks such as have been described, it is not uncommon to find a *contracture* of one or more limbs. This may assume the *hemiplegic* or *paraplegic* form; and it may be of a passing character, lasting a few days only, or enduring for many years. The attitude may be either that of rigid flexion or extension; and it is found to remain during sleep, only relaxing under the profound effect of chloroform narcosis. The limb so affected does not suffer in its nutrition, and the reaction of the muscles to electrical currents remains normal.

The contractures, as well as the sensory disturbances described below, may be said to be practically confined to patients of the female sex. It is very rare indeed to find them in males.

2. *Sensory.*—It has been noted that in female patients thus affected (as indeed is common in hysteria generally) there is apt to be a pain in one or other iliac region, most often the left, which is sometimes constant, and in other cases is only discovered by pressure. The seat of this pain is thought to be the ovary, and it is found that whilst a moderate pressure in this region may determine the production of the aura and sometimes of an hysterical attack, energetic compression at the spot will very often cut short the convulsive seizure.

Anæsthesia and *analgesia* are apt to be found sometimes in both sides, but much more frequently in one half of the patient's body, parted off from the other by the median line, and thus involving apparently half the head, face, and trunk, as well as the upper and lower extremities, though it may be in different degrees of intensity. It not seldom happens that the patient is herself unaware of the existence of this insensibility until examination has disclosed it. The loss of sensibility sometimes affects also the special senses; and smell, taste, hearing, sight, and the perception of colour, may each or all be lost on one side.

Accompanying the analgesia it is often seen that the pin-prick employed to test the condition fails to draw blood on the affected side, whilst readily doing so in the opposite limb.

Where there is loss of power of the limbs with contracture and anæsthesia following a convulsive seizure, it is not difficult for the condition to be ascribed to an attack of hemiplegia, resulting from organic disease, and there is sometimes a doubt on this matter which is not easily resolved. The points of most value in making a differential diagnosis are the following:—*a*. The absence *from the first* of any deviation of the tongue or facial paralysis. After a time, no doubt, in some cases of hemiplegia of organic origin these symptoms become scarcely visible, but it may be said that practically at the onset they are always present to a greater or less extent. *b*. The extent and completeness of the analgesia, especially the mode in which it affects the trunk, which ordinarily escapes in hemiplegia. Such complete anæsthesia as occurs in these cases is rarely observed in hemiplegia of cerebral origin. In spinal hemiplegia, again, it would occupy, as Brown-Séquard has pointed out, the side of the body *opposite* to that affected with motor paralysis. Besides these there is rarely much difficulty in finding in the symptoms, surroundings, or history of the patient, circumstances which, combined with those described, throw a strong light on the nature of the condition. The hysterical patient may present, for example, retention of urine, ovarian tenderness, and tympanites; and in her history there may be an account of aphonia, convulsive seizures occurring under emotion, hysterical cough, or some other feature which tends to stamp the case as one belonging to this great neurosis.

Occasionally these contractures remain permanent. Much more frequently they relax, after a longer or shorter period, and the relaxation almost always takes place suddenly, usually under the influence of some moral shock.

It will sometimes happen that paresis and contracture of a limb will occur without any previous history of hysterical symptoms, and the possibility of this must always be borne in mind. Where there is during many hours a long-continued succession of fits with brief intervals of immunity, considerable doubt may arise as to the nature of the attacks, because a very similar, numerous, and rapid recurrence of fits sometimes takes place in true epilepsy. We are indebted to Charcot for the observation that whilst in the case of the epileptic seizures of this kind the temperature is observed to rise greatly (attaining, for instance, a height of 105° F.), no such great increase is noted when the fits are of hysterical origin—a slight elevation only occurring.

In cases of hystero-epilepsy it has been noted that there is often colour-blindness, affecting the eye on the same side as the hemianæsthesia—the order of disappearance, in most cases, being the following:—violet, green, red, orange, yellow, blue. Violet is the colour most easily lost, red and blue, according to Charcot, being those which persist most, except in those cases where achromatopsia is absolute, that is where the patient

looking at a painting sees nothing but black and white.

Remarkable results have been known to follow the application of metallic plates and the approach of a powerful magnet to the anæsthetic side of the body. It is found that if a small plate of some metal be applied for a few minutes to the skin, a return of sensibility occurs, touches and pricks previously unperceived are felt, and colour-vision is restored in the affected eye. The particular metal which will effect this change has to be sought by experiment; in one person gold, in another silver, in others again iron, tin, or copper, alone producing the effect. So again it is stated that the approach (without actual contact) of a powerful horse-shoe magnet will produce a similar effect to the contact of a metal. In either case, *pari passu* with the return of sensibility on the affected side, it is noted that the other half of the body acquires the anæsthetic state. There is a transference apparently of the phenomena. The approach of a magnet, it is also found, will cause a contracture to relax, the relaxation lasting for many hours. But in this case, again, the corresponding limb of the previously normal side is found to present evidence of paresis. In two instances Rosenthal and the writer have found defective electrical excitability, as tested by sudden interruption of a strong voltaic current, in the cerebral hemisphere opposite to the side which is marked by anæsthetic symptoms. In the writer's own case the experiment was followed by considerable improvement in the cutaneous sensibility.

Treatment.—Cases of hystero-epilepsy are not amenable to any treatment by drugs. Powerful moral impressions, especially energy and commanding influence in the medical attendant, are more potent than anything else in bringing about recovery, but it is not always that these can be brought to bear. It is desirable, therefore, that in suitable cases the influence of the measures just described should be tested. In cases of convulsion strong pressure should be made upon that ovarian region in which tenderness is discovered. In examples of contracture and hemianæsthesia an application of metallic plates of various kinds may well be made to the skin of the affected side.

Very useful effects are often produced by the application of strong Faradic currents, which may require to be persisted in ere any influence is produced. Blisters also repeated every three or four days are occasionally very useful in causing the relaxation of a contractured limb and the return of sensibility to an anæsthetic skin.

Removal of the patient from the family circle and the society of frightened or sympathising friends, is in most cases a *sine quâ non* of successful treatment.

T. Buzzard.

I

ICE, Therapeutics of. *See* Cold, Therapeutics of.

ICHORRHÆMIA (ἰχὼρ, puriform matter, and αἷμα, the blood).—A morbid condition of the blood, caused by the absorption of septic materials. *See* Pyæmia; and Septicæmia.

ICHTHYOSIS (ἰχθὺς, a fish).—Synon.: Fish-skin disease; Fr. *Ichthyose*; Ger. *Fischschuppenausschlag*.

Definition.—An affection of the skin which has received its name from the breaking up of the cuticle into polygonal areæ, which suggest the idea of the scales of the fish. The surface of the skin is dry, rigid, rough, and greyish in colour; and the cuticle exfoliates in fragments, which in one place resemble dust, and in others are composed of thin glistening laminæ, like those of mica or bran.

Ætiology.—As a defect of development and normal growth of the skin, ichthyosis is a congenital affection, and often hereditary; and the degree of its manifestation will depend on accidental circumstances of various kinds, and more particularly on such as appertain to food and cleanliness.

Anatomical Characters.—In ichthyosis the cuticle is more abundant than natural; the fibrous tissue of the derma is condensed and hard; the papillæ cutis are enlarged and elongated; the subcutaneous connective tissue is lax and fatless; and the whole organ is devoid of succulence and elasticity. In a word, it may be said to be starved. The remaining characteristics of the disease are such as might be predicted from this description. The cuticle formed in excess is hard and brittle, and breaks up into fragments corresponding with the areæ of the lines of motion and wrinkles of the skin; the fragments being simply pulverulent in one part, as upon the inner side of the limbs, the neck, and front of the trunk; angular and prominent in the neighbourhood of the joints; and smooth, flat, and polyhedral on the internodal parts of the limbs. The follicles of the skin are filled with dry exuviæ and dry sebaceous substance, which in some situations concretes on the surface, thereby increasing the thickness of the epidermic crust. The skin as a whole is marked with coarse wrinkles, resulting from the stiffness and hardness of its substance; and from the looseness of the subcutaneous tissue, it moves freely on the fascia beneath. While the general character of the integument is that of want of harmony as to growth with the rest of the body of the individual, there is a defect

of the oily secretion of the skin, sometimes also of its aqueous secretion; a want of the clearness, transparency, and lustre which are met with in the healthy skin; and an exhalation of an unpleasant odour.

VARIETIES.—The most striking modifications of ichthyosis are to be looked for on the limbs, where the disease is most marked, and the scales of greatest magnitude; on the hands and feet, which are dry and horny and deeply wrinkled; on the neck and trunk, where the exfoliation is pulverulent; and upon the face, where the cuticle is shining, roughened by the edges of exfoliating laminæ, and seemingly distended, altering the complexion to a brick or apple-red. Another modification results from the presence of an excess of sebaceous substance, which, by its adhesion to the skin, produces prominent scales—*Ichthyosis sebacea*—varying in thickness in different parts of the body, and sometimes giving rise to spines of considerable length and thickness—*Ichthyosis spinosa*.

These modifications occasion a certain diversity of appearance in the affection, which has suggested a variety of synonyms. Thus, when its conspicuous symptom is dryness of the skin, we have termed it *Xeroderma*. When the network of lines which bounds its scales has attracted especial attention it has been named *Ichthyosis reticulata*. When the mother-of-pearl-like polish of the smooth area within the meshes of the lines of motion has been conspicuous it has been called *Ichthyosis nitida* and *Ichthyose nacrée*. When the concretion of the epidermic and sebaceous substance assumes the figure of the scales of reptiles, the term *sauriasis* is applicable, and *Ichthyosis serpentina*; whilst the elongated form of crust has given origin to the term *Ichthyosis hystrix*, the 'porcupine disease.'

TREATMENT.—These considerations lead us to the principles of treatment of ichthyosis, and suggest as primary indications:—*first*, to promote an improved nutrition of the body; *secondly*, to effect the removal of the excess of epidermic matter and sordes; and, *thirdly*, to stimulate the innervation and circulation of the skin by inunction and friction. The first of these indications is to be achieved by the use of nutritious food, cod-liver oil, arsenic, iron, and tonics in general; the second, by saponaceous ablutions and frictions, and especially by the Turkish bath and shampooing; and the third, by frictions of oily and gently stimulating liniments into the skin; one of the most suitable of these remedies for the purpose being the oleum theobromæ, or cocoa butter. ERASMUS WILSON.

ICTERUS (*ἴκτις*, a weasel; with yellow eyes). A synonym for jaundice. *See* JAUNDICE.

ICTUS SOLIS (*ictus*, a stroke; *sol*, the sun). A synonym for sunstroke. *See* SUNSTROKE.

IDIOCY (*ἰδιώτης*, a person private or apart). SYNON.: Feeble-mindedness; Fr. *Démence innée*; *Idiotisme*; Ger. *Die Spracheigenheit*; *Blödsinn*.

DEFINITION.—Mental deficiency occurring during infancy or the early periods of life.

The term *idiocy* is not a scientific one, but it is convenient to employ it here to include a class of maladies which differ essentially from insanity both as to their nature and treatment. The strict meaning of an idiot is, 'a solitary one,' but it has become so much used as a term of opprobrium that it were well if the phrase, 'feeble-minded,' could take its place.

DESCRIPTION.—The term idiocy covers such a large area, and includes such a great variety of cases, that there is endless gradation in its manifestations, from slight departure from a normal condition, to that state of profound idiocy in which the unfortunate subject thereof sees nothing, feels nothing, does nothing, and knows nothing. The typical illustration, however, is best conveyed by reference to an average condition. For the most part, the lesion is not only a psychical one, but profoundly affects the physical, and frequently the moral life. The stature is less than normal, with great tendency to assume a stooping posture. The skin is often coarse, deficient in elasticity, and lax, with increased development of areolar tissue. The muscles are weak and flabby, and respond feebly and irregularly to the action of the will. The bones are often yielding and deformed. The circulatory system is usually weak, rendering the patient liable to destructive chilblains and frostbite, inducing perilous effects from exposure to a low temperature, and rendering slow any reparative process. The lungs are extremely liable to inflammatory attacks, both in their bronchial tubes and parenchyma, and prone to tubercular disease if the subject be resident on a clay soil. The digestive system is liable to be deranged by defective mastication of food, and alternately subject on the one hand to constipation from defective innervation, and on the other hand to diarrhœa from catarrh, resulting from rapid alternations of temperature. The sexual functions are often abnormal; there is a tendency to masturbation very early in life, while puberty itself is generally delayed, and often sterility exists. There is not unfrequently phimosis and undescended testis in the male, and non-development of the ovary in the female. The motor functions are abnormal; there is usually defective co-ordination, resulting in a deficiency in purposive acts, while there is a tendency to the production of purely rhythmical and automatic movements. There is diminished sensibility, so that what is painful to others is borne with complacency. Speech is defective, partly from want of co-ordination of the muscles of the tongue, partly owing to deformations of the mouth and palate, and partly to inability to convert ideas into words. The sight is often defective, due to hypermetropia, to imperfect retinal sensibility, to congenital cataract, or to diminished accommodation. These conditions are frequently associated with strabismus or nystagmus. The sense of smell is lessened, and the discrimination of odours almost *nil*. The sense of taste is defective, leading to the eating of things of an unpalatable, and even repugnant nature. The faculty of hearing is not much interfered with, except in cases where there has been destructive disease of the ear. The faculties of observation and attention are limited. There is generally great fondness for music, and simple airs are often readily learned. The memory is not usually very defective, and there are often instances of remarkable power in this respect. There is very little imagination or

power of abstract thought, while judgment and reasoning power are almost entirely absent.

Classification.—The best classification of idiocy, the one which most assists in the prognosis and treatment, is that which is based on its ætiology. The whole of the cases may be divided into three important groups, which groups afterwards admit of subdivision. The primary groups are:—1. *Congenital*; 2. *Developmental*; and, 3. *Accidental*.

1. *Congenital idiocy.*—The congenital group includes all those cases which at the period of birth manifest signs of defective mental power, associated usually with conditions of the head, skin, and other organs, which are indicative of a congenital origin. They are cases which have never possessed ordinary mental power. The congenital group contains the following subdivisions:—*a*. Strumous; *b*. Microcephalic; *c*. Macrocephalic; *d*. Hydrocephalic; *e*. Eclampsic; *f*. Epileptic; *g*. Paralytic; and *h*. Choreic.

2. *Developmental idiocy.*—The developmental group includes a smaller number of cases, where the child is born manifesting an average intelligence through infancy, or even up to the commencement of puberty, but from causes which have influenced the nutrition of the embryo during its intra-uterine life, is born with a proclivity to mental break-down during one of the developmental crises; the crises being the periods of the first dentition, of the second dentition, and of puberty. The group includes those cases in which speech and mental faculties are lost in children in whom previously the intelligence was good—cases where the brain and nervous power was sufficient for its early years, but insufficient to carry it through evolutional stages. They usually present outward signs in their cranium or elsewhere that the tendency to catastrophe was born with them. The developmental group embraces the following subdivisions:—*a*. Eclampsic; *b*. Epileptic; and *c*. Choreic.

3. *Accidental idiocy.*—The accidental group includes all those cases of idiocy where the child has been born with a normal nervous system, free from any present or potential defect, when unfortunately a fall, a fright, epilepsy, the result of some peripheral irritation, disease of the bones of the ear sequential to measles or scarlet fever, meningitis, or other cause, may lead before puberty to mental break-down—a break-down not of a genetic, but of a purely accidental origin. (For the group of idiots produced by endemic influence *see* Cretinism.) The accidental group includes:—*a*. Traumatic; *b*. Inflammatory; and *c*. Epileptic idiocy.

Ætiology.—The production of idiocy is multiform in its causation; often more than one factor has been at work. The *congenital* kinds are produced by neuroses, struma, tuberculosis, alcoholism, over-intellectual work, over-sexual indulgence, and constitutional debility of the progenitors. Syphilis holds but a very unimportant place. Intermarriage of relations, *where there is a constitutional taint*, in consequence of its insuring the existence of two potent factors; fright and emotional disturbance, or anxiety of any kind on the part of the mother during her pregnancy; and prolonged parturition and suspended animation at birth, are also to be reckoned as causes of congenital idiocy. The *developmenta* kinds have their proclivity given to them by causes affecting their nutritive life *in utero*; notably emotional disturbances, and sickness produced by the pregnancy or a prolonged sea-voyage. The exciting cause is a developmental crisis, such as occurs at the periods of dentition, and the evolution of puberty. Masturbation is a most important factor in determining this kind of idiocy. The *accidental* kinds are produced by injuries to the cranium of any kind, sunstroke, exanthematous disease, tubercular or other forms of meningitis, inanition, epilepsy referable to worms, masturbation, or other sources of peripheral irritation.

Prognosis.—In idiocy the future of the patient will be forecast by reference to the nature of the case. Other things being equal, patients paralysed or epileptic are less amenable to treatment than others, but the worst results are obtained among cases of accidental origin. It is important to recognise the fact that congenital cases, with marked traces of their infirmity in their faces and bodies, are, for the most part, more susceptible of improvement than the developmental, and these again than the accidental, who may have no appearance of idiocy in their faces or bodies; that, in fact, the prognosis is often inversely as the patient is winsome, fair to look upon, and comely.

Treatment.—The treatment of idiocy consists of a judicious combination of medical, physical, moral, and intellectual agencies. The patient should be rescued from his *solitary* life, and have the companionship of his peers. He should be surrounded by influences, both of Art and Nature, calculated to make his life joyous, to arouse his observation, and to quicken his power of thought. The basis of all treatment should be *medical* in an enlarged sense. Success can only be obtained by keeping the patient in the highest possible health. The dietary should be liberal, containing a fair proportion of nitrogenous elements, while rich also in phosphatic and oleaginous constituents. The food should be presented, too, in a form suited to the masticatory power of the patient. It is of importance that the rooms should be well-ventilated, whilst kept warm; and daily baths with shampooing should be employed. Of first importance is the soil: a clay soil is fatal to all proper progress, inducing tuberculosis, and lowering the vital power. *Physical* training forms an important part of treatment. The attenuated muscles have to be nourished by calling into exercise their functions, and the automatic and rhythmic movements have to be replaced by others which are the product of the will. The simplest movements should be first taught, then the more complex, thus causing to grow up together the mandate and the result. From purposeless acts the idiot thus builds up a series of co-ordinated and voluntary movements which are applicable to the wants of daily life. The training has to be carried out in minute detail, so that every voluntary muscle and every congeries of muscles may be called into action, and trained to fulfil with rapidity the end for which they are designed. The *moral* education is of paramount importance. The pupil has to be taught to subordinate his will to that of an-

other. He has to learn obedience, that right doing is productive of pleasure, and that wrong-doing is followed by deprivation thereof. Corporal punishment should be forbidden; the affective faculties of the patient should be cultivated, that the deprival of the love of his teacher should be felt as the greatest punishment, and the manifestation of it his highest reward. In no case should the punishment interfere with hygienic treatment. The *intellectual* training must be based on a cultivation of the senses. The patient should be taught the qualities, form, and relation of objects by their sense of touch; to apprehend colour, size, number, shape, and relation by sight; to understand the varieties of sound when addressed to the ear; the qualities of objects by the taste and smell. These lessons should be of the simplest at first, and gradually cumulative. Nothing should be left to the imagination. The idiot must be taught the concrete, not the abstract. It is in this way we should give him the basis from which the reasoning and reflective faculties can be built up. Synchronously with this, use should be made of the physical powers which have been cultivated. He should be taught to dress and undress himself, to acquire habits of order and neatness, to use the spoon or knife and fork, to walk with precision, to handle with tact. The defective speech is best overcome by a well-arranged plan of tongue-gymnastics, followed by a cultivation of the purely imitative powers. J. Langdon Down.

IDIOPATHIC (ἴδιος, peculiar, and πάθος, a disease).—A term applied to a morbid condition when it arises primarily, and not in consequence of some other disease or injury. It is used in contradistinction to *symptomatic* and *traumatic*.

IDIOSYNCRASY (ἴδιος, peculiar; σὺν, with; and κρᾶσις, constitution or temperament).

Definition.—This term, like many others used in science, has a more restricted application than its etymology would indicate. From meaning the personal constitution of an individual, it has come to mean any peculiar and not obviously correlated reactions against external influences exhibited by any individual. It is not to be confounded with 'constitution,' which is the foundation of the individual, his powers, capacities, and organisation; nor with 'temperament,' which denotes the correlation of powers and tendencies with the physical conformation of the individual, which has thereforé a generic or race application, and which is defined by some writers as the 'general form' of the man. Commonly, any single peculiarity of a person is spoken of as 'an idiosyncrasy,' so that one individual may, in this sense of the word, manifest several idiosyncrasies or personal attributes.

Description.—Idiosyncrasies, so defined, may be mental or physical; may be innate or acquired; may be permanent or temporary.

The existence of idiosyncrasies being declared chiefly through the agency of nerves, and their operations being mostly capable of being brought under laws of innervation, Prochaska, Claude Bernard, and other authorities have regarded them as 'a peculiar affection of the nervous system.' But a review of the phenomena admitted to belong to the class will be found to compel us to recognise in many cases a more comprehensive relation, involving the whole organism, or parts of it other than the nervous system.

In the enumeration of the principal kinds of idiosyncrasies, to purely mental manifestations of likes and dislikes toward persons, things, and pursuits,—affections covered by such terms as 'sympathy,' 'antipathy,' 'predilection,' etc.,—must be added reactions in which the mind, the emotions, and the organic nervous system are affected simultaneously, but in varying proportions, by impressions received through organs of sense.

For example, vision may be the channel of affection. Syncope is produced in some persons by the sight of blood; or, as is related by Prochaska, swooning may invariably occur on the sight of beetroot. As regards olfaction, some people are distressfully affected, in both bodily and mental ways, by the exhalations from certain animals, the cat in particular; in others, horror and fainting are induced by the odour of roses or of apples. And so on through the rest of the senses.

In another group of idiosyncrasies the higher nervous centres play no part, the phenomena being of reflex production through the spinal centres, or being due to direct poisoning of the system or of organs. Among foods or drugs swallowed, among gases or dusts inhaled, among substances brought into contact with the skin, many, harmless to the majority of men, are for this or that individual irritants or poisons. For instance, eggs, honey, sugar, or fish may produce gastric pain, nausea, or vomiting; strawberries are to a few persons a most deadly poison, producing symptoms of intense nervous shock; convulsive spasms may be excited by the smell of musk or civet; asthma by the inhalation of the powder of ipecacuanha; urticaria by the eating of shell-fish, or even by the application of the yolk of egg to the skin.

> Some men there are love not a gaping pig;
> Some that are mad if they behold a cat;
> And others, when the bag-pipe sings i' th' nose,
> Cannot contain their urine.
>
> *Merchant of Venice.*

Idiosyncrasies confronting the use of drugs have a special interest for the medical man. They may be of a qualitative nature, as in the production of unusual symptoms with dangerous or fatal results by anæsthetics, or in iodism; or of a quantitative nature, as in the case of opium and belladonna, minute doses of which will poison some persons, while doses of them, large enough to destroy a dozen average individuals, may be taken by one here and there with impunity.

The consideration of this part of our subject introduces the question of the variations of idiosyncrasies. The transient oddities of susceptibility arising in pregnancy, hysteria, and madness, are excluded by some authors from the category, but as they only differ in their transitory character from other idiosyncrasies, we shall here associate them with those modifications of reactive sensibility to which the term is commonly extended. Seeing that the causes of innate idiosyncrasies are for the most part unexplained, we may search out in varying or acquired idio-

syncrasies varying correlations which may help us to the ultimate better understanding of the former group. Thus we know that intolerance of opium may arise in some morbid states the nature of which is fairly known; that tolerance of, or comparative indifference to, the same drug may be attained by its constant use. As in pregnancy new idiosyncrasies appear, so age, habits, and state of body may each and all modify the reaction of any individual towards his surroundings; may change his behaviour under the influence of drugs; may at one time charm him against morbid poisons, at another time leave him their easy victim; may make him inflame sometimes in a suppurative, sometimes in a plastic way. From this point of view, we may with Claude Bernard summarise idiosyncrasies as being 'mere manifestations of the ordinary laws of physiology.'

Imaginary idiosyncrasies.—Persons are not unfrequently met with who, held by prejudice, or misled by fancies or unsound judgments, declare that particular foods and medicines disagree with them. It may often be found, on investigation, that the assertion is incorrect. The obstacles offered to effective treatment by such fancies are sometimes of grave importance, tasking severely the sagacity of the medical man in the way of analysis, and his skill in the way of counteraction. But when the idea of their existence shall have been proved in any case to be unfounded, it is generally possible to evade such obstacles by tact, or to undermine them by argument, and, most of all, to dissipate them by firmness. WILLIAM M. ORD.

IDROSIS (ἱδρῶs, sweat). A synonym for hyperidrosis. *See* PERSPIRATION, Disorders of.

ILEO-TYPHUS.—A synonym for typhoid fever. *See* TYPHOID FEVER.

ILEUM, Diseases of. *See* INTESTINES, Diseases of.

ILEUS (εἰλέω, I twist).—A synonym for an intestinal obstruction. *See* INTESTINAL OBSTRUCTION.

ILIAC REGION.—The iliac region, or region of the iliac fossa, is limited laterally and superiorly by the crest of the ilium, anteriorly by Poupart's ligament, and internally and below by the brim of the true pelvis or inner edge of the psoas magnus muscle.

ANATOMICAL RELATIONS.—That portion of the abdominal cavity which corresponds to these boundaries, contains the following viscera on the right side:—the cæcum, the vermiform appendix, some coils of the small intestines, and the ureter; and on the left side:—the sigmoid flexure of the colon and small intestines, and the ureter.

In front of the cavity is the ilio-inguinal region, which forms its anterior parietes, and from which surface all examinations of the region are instituted. Exploration is difficult in obese persons, and to facilitate it we must relax the abdominal parietes by flexing the thigh, and by pressing the fingers immediately above the crural arch.

The *peritoneum* is but very slightly united to the subjacent tissues, and is easily separated from them. It completely covers in the left iliac fossa; but on the right side, owing to the presence of the cæcum, this investment is incomplete (*see* LUMBAR REGION).

The *sub-peritoneal cellular tissue* may be regarded as being composed of two distinct layers. The first, immediately beneath the peritoneum, is a continuation of the lax cellulo-fatty envelope of the kidney and cæcum, passing with the femoral vessels into the crural canal, and with the spermatic cord into the scrotum. The deeper or sub-aponeurotic layer lies beneath the sheath of the iliaco-psoas muscle, being continuous above with the sub-pleural cellular tissue, and accompanying this muscle downwards as far as its insertion into the lesser trochanter.

The *arteries* of this region are the common and external iliac, and their branches.

The *nerves* of the iliac fossa are the lumbar plexus (the trunks of which lie in the iliaco-psoas muscle) and its branches; and the solar, renal, hypogastric, and lumbo-aortic branches of the sympathetic.

The *fascia iliaca* is attached above to the entire inner lip of the iliac crest. Internally it is blended with the sheath of the psoas at the level of the promontory of the sacrum; and below this point it becomes fixed to the brim of the true pelvis, passing behind the vessels and giving off a thin cellular lamella in front of them.

The *sheath of the psoas muscle* is attached above to the ligamentum arcuatum internum; it encloses the psoas anteriorly (the posterior portion of its envelope being formed by the lumbar vertebræ); it is blended externally with the sheath of the quadratus lumborum; whilst internally it is attached to the anterior common ligament. Inferiorly it is continuous with the fascia iliaca.

The *osseous layer* corresponds with the iliac bones.

PATHOLOGICAL AND CLINICAL RELATIONS.—The viscera which have been enumerated above, as being contained in the iliac region of the abdomen, present various diseased conditions, which cannot be satisfactorily diagnosed without a practical knowledge of its anatomical relations, and especially of the fasciæ, sub-aponeurotic, and aponeurotic structures of the iliac region. Thus in the right iliac region the physician meets with tumours and other diseases of the cæcum, vermiform appendix, and lower part of the ileum, including the local lesions of typhoid fever (*see* CÆCUM, Diseases of). In the left iliac region, the diseases of the sigmoid flexure possess equally important relations. The tumours, extravasations, and abscesses, which may commence in the pelvis, frequently make their way into either iliac region; and this is also the seat of morbid conditions connected with the ureter in the middle portion of its course, as well as partly of the pain in renal calculus. In the sub-peritoneal tissue we meet with bloody or urinary infiltrations, fæcal abscesses, and perityphlitic or idiopathic abscesses independent of any intestinal lesion. Collections of pus beneath the fascia are generally dependent on caries of the vertebræ, and may either be confined to the iliac fossa, or lie within the sheath of the psoas muscle (psoas abscess).

Again, lumbar abscesses may point anteriorly, and be diagnosed by palpation of the abdominal walls.

This region is the seat of ligature of the common, external, or internal iliac arteries. The pulsation of the two former can generally be felt; and it must be borne in mind that the abdominal aorta pulsates in the left iliac region.

EDWARD BELLAMY.

ILLUSION.—A false or mistaken perception of one of the senses, as when a person sees or hears something, and takes it to be something else. The term has been used as synonymous with delusion and hallucination. Illusions may occur in the sane as well as the insane. *See* HALLUCINATION.

IMBECILITY. *See* DEMENTIA; and IDIOCY.

IMPETIGINODES.—Impetiginous; that is, having the character of impetigo; hence, eczema impetiginodes. *See* IMPETIGO.

IMPETIGO.—SYNON.: Fr. *Impétigo*; Ger. *Eiterflechte.*

DEFINITION.—A term used by Celsus and Pliny, apparently signifying *ab impetu agens*, that is, breaking out with violence or impetuosity. In modern dermatology the term is restricted to an eruption of small pustular vesicles, accompanied with but little redness or inflammation, and that of a superficial character; hence, the individual pustules have been termed *psydracia* or 'cold pustules,' in contradistinction to the pustules of ecthyma, which are termed *phlyzacia*, or 'hot' and inflammatory pustules.

ÆTIOLOGY.—Impetigo is an outbreak of a sensitive and weakly skin, associated with nutritive debility; and is more common in children and women than in men.

VARIETIES.—Impetigo presents itself in three forms. First, it occurs as an eruption of isolated pustules, distributed more or less generally, when it is called *Impetigo sparsa*. Secondly, it is found as a congregation of pustules forming blotches, rarely exceeding one or two inches in diameter, constituting *Impetigo conferta* and *Impetigo figurata*. And, thirdly, it is seen as a complication of eczema, representing a pyogenic tendency, as *Eczema impetiginodes*. In children it is apt to occur on the face, hands, and feet, and particularly in the region of the mouth, nostrils, and ears; and, from its frequent spreading through a whole family or neighbourhood, has awakened a suspicion of contagion, and as such, received from the late Dr. Tilbury Fox the name of *impetigo contagiosa* (*see* IMPETIGO CONTAGIOSA). Dr. Fox likewise detected epiphytes in this form of eruption. Nevertheless, impetigo will best be regarded as a simple pyogenic eczema, and not ordinarily contagious.

DESCRIPTION.—Pathologically, impetigo is a vesicle containing pus or a muco-purulent fluid, rather than a true pustule, and varies in size from a mere point, not larger than a pin's head, to a hemisphere of a quarter of an inch in diameter. With the smaller dimension, it often occupies the aperture of a follicle; whilst when more extensive, it spreads over the surface occupied by several of these apertures. The colour of its contents likewise varies in different specimens, being sometimes brightly yellow, at other times cream-coloured, and in the 'epidemic' variety almost colourless. After a few days the secretion dries up into a crust, of yellowish or brownish colour; and the crust varies in figure and thickness according to the activity of the secreting process, or the undisturbed condition of the pustules. On the face of children it will sometimes dry up into a crust of considerable dimensions; and in this state, when it retains its yellow colour, is an example of what the ancients denominated *mel litagra*. More frequently, however, the crust is discoloured and blackened by admixture with blood; and when associated with eczema, is capable of forming a mask over the whole face—*Impetigo larvalis*—or, in the case of infants at the breast, an impetiginous *crusta lactea*.

PROGNOSIS.—The prognosis of impetigo turns upon the fact that it results from nutritive debility. It is perfectly curable, is by no means grave in its nature, and disappears completely when the health and strength of the patient are restored; in ordinary cases, in two or three weeks.

TREATMENT.—If any derangement of digestion and secretion be evident in a case of impetigo, this should be regulated before tonics are resorted to. The diet and regimen should be nutritive and wholesome; while the tonics most suitable to such cases are iron, quinine, arsenic, nitrohydrochloric acid, and cod-liver oil. Locally, the blotches should be kept covered with the oxide of zinc ointment, or with a lotion of lime-water and oxide of zinc. The former of these remedies preserves the softness and pliancy of the crusts; whilst the latter dries them up. Both processes promote their removal; and in the selection of the remedy the best guide will be the amount of discharge, the degree of irritability of the skin, and especially the sensations of the patient.

ERASMUS WILSON.

IMPETIGO CONTAGIOSA (*impetigo*, a scabbing disease of the skin; *contagiosa*, contagious).—DEFINITION.—A contagious vesico-pustular disease; sometimes epidemic; attacking children in the vast majority of cases; and often affecting several members of the same family.

SYMPTOMS.—This disease, which was first described by the writer, is sometimes attended at the outset with pyrexial disturbance. The eruption first makes its appearance about the face, and indeed is chiefly marked in this situation; but it may appear on the neck, head, and limbs, and more rarely on the trunk. The eruption is composed of one or more crops; and begins by the formation of vesicles, which develop into little bullæ. The contents of these become milky, and then sero-purulent; and speedily dry into light-yellow scabs which look as if stuck on, unless the spots are injured by scratching. Mothers describe these little vesico-pustules in their early stage as 'little watery heads' or 'watery pocks.' The significant features of these spots are their separateness; their superficiality; their replacement by the flattened scabs; and the contagious quality of the fluid contents of the vesico-pustules. Very often bullæ appear about the hands of the children affected.

Treatment. — The treatment of contagious impetigo consists in applying the unguentum hydrargyri ammoniati in a diluted form to the red surfaces beneath the scabs, by which the characters of this secreting surface are altered, so that the disease is not spread by auto-inoculation. As each spot tends to run a definite and short course, the whole disease is quickly cured by the prevention of its spread in this manner. The general health may require attention. Tilbury Fox.

IMPOTENCY (*in*, not, and *potens*, capable). Synon.: Fr. *Impuissance*; Ger. *Impotenz*.

Ætiology and Pathology.—Impotency implies an incapacity for sexual intercourse, and it arises from various causes. The testicles are the organs which furnish spermatozoa, the element essential to impregnation. Their functions may become suspended, or be incapable of excitement; or they may be exerted to excess, improperly excited, and so abused as to fail prematurely; or these organs may become impaired or destroyed by disease.

The impulse for commerce with the other sex exists in different degrees of force in different men. A certain degree of vigour is necessary to bear the nervous excitement attending it; hence in advanced years, and in weak and susceptible individuals, the frame is unable to sustain frequent coition with impunity. Rules have been given for regulating the sexual functions, and restricting their exercise within due bounds. They are, however, of little value, for the powers vary greatly in different persons, and also at different periods of life, and what is moderation in one man, or at one period of life, is excess in another man, or at another time of life. Whenever the sexual act is followed by a prolonged sense of debility and lassitude, an uncomfortable feeling in the head, and disinclination for either physical or mental exertion, the limits consistent with health have been exceeded.

In adult persons of recluse and studious habits the testicles often continue dormant for years. Like the mammæ in the unmarried female, though inactive, they remain sound and competent for secretion when duly excited and called upon to exercise their functions. The case is different later in life. Thus widowers, after remaining chaste for some time, on marrying have been doomed to disappointment. Inaction has hastened the natural decline. After middle age, as life advances, the testicles diminish in size, and become soft and flaccid; the secretion of semen becomes languid; and the desire and power to indulge in coition gradually subside. The period of life at which these changes become marked varies in different men, but most persons are conscious of some decline in sexual vigour after the age of forty. There are some remarkable instances on record of men who are reported to have been capable of the reproductive act in very advanced life. Cato, the censor, is said to have had a son at eighty years of age. Zadislas, king of Poland, at the age of ninety, married his second wife, and had two sons. The writer has often detected spermatozoa in the fluid from the testicles of very old men, one a tailor aged eighty-seven. Duplay discovered them in nine octogenarians. Though the scantily secreted sperm may retain its fecundating properties, old men may still fail in the other conditions essential to the due performance of the sexual functions.

The testicles are under the influence of the brain, which animates and controls the desire for sexual intercourse. An emotion of the mind, as sudden disgust or anger, arrests the secretion of these glands as quickly and as effectually as a strong mental impression stops the secretion of gastric juice, and takes away the appetite for food. An attack of apoplexy, or severe injury to the head, may extinguish all desire as well as capacity for coition. A gentleman, aged thirty-four, had a concussion of the brain which rendered him insensible for twelve hours. For four months afterwards he lost all sexual power, and on its recovery it remained feeble. There are several cases on record in which severe injury of the head has been followed by complete wasting of the testicles, as well as by permanent impotency. Diseases and injuries of the spinal cord, producing paraplegia, have no direct effect on the testicles, but destroy the power to copulate.

Some men are but little susceptible to the influence of the female sex, and though of vigorous mould, they have not only passed a life of absolute chastity, but have never evinced the slightest disposition for sexual enjoyment. This arises probably from some cerebral imperfection. Owing to the same cause, the testicles may remain undeveloped in adult age, attended with an absence of sexual desires. Cases of wasting of the testicles after injuries of the head, and the non-development of these organs, with absence of the venereal appetite, in certain cretins and idiots, tend to strengthen this view.

The most common cause of impotency is want of self-confidence—excessive apprehension of inability to perform well the duty of the sex, a feeling which is often greatly aggravated by the perusal of the productions of quacks and other impostors. When persons entertain these groundless fears, it may be long before success attends their efforts, every failure adding to the evil by diminishing the reliance upon their powers. In the case of persons recently married, who may be affected with this form of impotency, a tonic may be prescribed, and the patient be directed to abstain from all attempts at intercourse whilst under treatment, and we may rest satisfied that not many days will pass over before nature asserts her empire. These cases must not be lightly treated. The patient is in great distress of mind. The true cause of failure may be explained to him, and he may be confidently assured of the groundless character of his fears, and of the influence of his doubts and apprehensions in preventing him from fulfilling his desires. Encouraging assurances will do more in effecting a cure than stimulating medicines or any sort of medical treatment. A single success banishes at once all his fears, and gives security for the future.

Excessive exercise of the sexual functions is a frequent cause of impotency, and its too early indulgence often entails a loss of power in middle age. This is often the case in the despotic countries of the East. Another result of inordinate excitement of the organs is frequent involuntary discharges of the spermatic fluid. Varicocele tends gradually to impair the nutri

tion, and diminish the secreting powers of the testicles. When limited to one side, as usual, a varicocele need not disturb the mind of the patient. Diseases which destroy the substance, or produce wasting of the testicle, necessarily prevent its secreting. The functions, however, of this gland are not very readily impaired by disease, and so long as a small part remains entire, the organ may be fitted to perform its office sufficiently for the end destined by nature. A person who has lost both testicles by operation after arriving at puberty, may experience desire, have erections, accomplish coitus, and even emit fluid for many months and even years afterwards, but he soon loses the capacity to impregnate, and all sexual power gradually subsides.

Virility is more or less affected by constitutional diseases. Few complaints have greater influence in impairing the generative functions than those of the kidney. Diuretics, as the nitrate of potash, carbonate of soda, &c., are well known to act as anaphrodisiacs. In irritative dyspepsia, with deposits in the urine of earthy phosphates or oxalate of lime, there is generally some inability. Impotency in these cases is only one of the manifestations of defective assimilation and depressed vital force. The treatment of such cases by mineral acids and other remedies calculated to improve the general health is very successful in restoring sexual vigour. In diabetes and albuminuria the reproductive organs are weak and often quite inactive, but may regain tone as the kidneys are restored to a healthy state.

Impotency sometimes occurs in middle life without any obvious cause. In such persons the writer has noticed a constitutional change similar to that which occurs in eunuchs, but less marked. They have been observed to grow sleek and corpulent, to have a scanty beard, and to be indisposed to active muscular exertion. In general they evince no unhappiness at their altered condition. In atonic impotency, the external organs afford indications of the want of power. Not only are the testicles soft and flaccid, from the absence of blood in the vessels and sperm in the tubes, but the penis is small and shrivelled, and the glans relaxed. The scrotum is also loose. These parts are pale, feel cold, and their sensibility to contact is diminished.

Treatment.—Certain medicines, reputed to possess the property of stimulating and invigorating the sexual organs, have been classed as *aphrodisiacs*, and some of them are said to be used, especially in the East, by the sensualist, to excite the organs when exhausted by satiety and excess. Several act on and stimulate the urinary organs, and thereby give temporary power to the function of erection; but they produce little or no effect on the special sexual organs. They determine blood to the penis, and cause morbid erections, without any voluptuous sensations and desires. Such appears to be the character of the influence produced by cantharides, the most common of this class of medicines, and the chief ingredient of quack medicines for impotency. There are, however, certain cases in which cantharides is useful. In an atonic state of the organs, in which the erections are feeble, unstable, and insufficient—ten to fifteen minims of the tincture may be given every three or four hours for a short time before the occasion arises for the exercise of the sexual functions. Dilute phosphoric acid, the phosphate of iron, the liquor strychniæ, and ergot of rye are remedies which may be given in impotency. The conditions to which these aphrodisiac remedies are chiefly applicable is when the intromittent organ is but feebly excited, and does not maintain the physical state necessary for penetration, during the period of congress. Such torpidity may exist in persons in whom desires are at times strongly felt, and the functions of the testicles properly performed. In these cases, also in timid persons, and in others whose organs are inexcitable from long disuse, stimulating treatment may conduce to success, and ensure confidence for the future. But these remedies exert no influence in a constitutional apathy of the sexual functions. They have rarely, also, more than a temporary effect; and in persons advanced in life, when the parts, having fulfilled their office, are experiencing their natural decline, they operate injuriously, and tend to produce congestion of the prostate and local disease. In those cases also in which the sexual organs are weakened or prematurely exhausted by excess, they are likewise hurtful, as well as fruitless. After such abuses a period of repose is required, and by the avoidance of all sources of excitement, and by diet and remedies adapted to invigorate the body, such as the preparations of steel, a gradual restoration of the procreative functions may be hoped for.

Electro-magnetism is a remedy of some efficacy in certain forms of impotency. Interrupted currents (Faradic) may be passed in two directions, from the perineum to the glans penis in cases of defective erectile power, and from the groin along the spermatic cord to the testicles, in cases where these organs are soft and flaccid, and where secretion is languid. The results are often disappointing. In cases in which the desires are strong, but the erections feeble, the sensibility of the glans penis is so lowered that the friction of coition is incapable of maintaining prolonged distension of the organ, and erection subsides shortly after penetration and before completion of the act. A few applications of the electric current, by rendering the glans penis more sensitive, may cause a more persistent distension of the organ under the natural excitement. Electro-magnetism succeeds more frequently in impotency of this character than where, in addition to defective erection, the desires are feeble, and the testicles soft and inelastic; and yet the repetition of the remedy has succeeded in some instances of this less hopeful kind in rousing a dormant power, causing secretion to be resumed and erections to return. The special treatment required in cases due to injury of the central nervous system, after recovery from head-symptoms, is the use of electro-magnetism, applied from the occiput along the spine.

T. B. Curling.

IMPULSE (*impello*, I thrust forwards).—A sensation of a stroke communicated to the hand, for example, by the action of the heart or the pulsation of an aneurism; or by the sudden movement of a fluid when agitated in any way

(*see* PHYSICAL EXAMINATION). The term is also employed in connection with a mental condition in insanity. *See* INSANITY, Varieties of.

IMPULSIVE INSANITY. *See* INSANITY, Varieties of.

INCARCERATION (*in*, in, and *carcer*, a prison).—A condition of hernia in which it cannot be reduced, on account of obstruction at the neck of the sac or from some other cause. *See* HERNIA.

INCOHERENCE (*in*, not; *con*, together; and *hæreo*, I stick).—Inconsecutive or 'wandering' thought, as expressed in speech. *See* CONSCIOUSNESS, Disorders of.

INCOMPETENCE (*in*, not, and *competo*, I meet accurately).—In its general sense this term' signifies inability of a part to perform its functions. It is mainly applied to imperfection in the closing apparatus of an orifice, such as the valves of the heart or the pylorus. *See* HEART, Valves of, Diseases of.

INCOMPRESSIBLE.—Incapable of perceptibly yielding to pressure. Usually applied to the pulse. *See* PULSE.

INCONTINENCE (*in*, not, and *contineo*, I hold).—In medical language incontinence signifies inability to retain the urine or fæces, so that they are discharged involuntarily. *See* DEFÆCATION, Disorders of; and MICTURITION, Disorders of.

INCUBATION (*incubo*, I hatch).—DEFINITION.—The development of disease from infecting particles, and the time occupied in the process.

PERIOD OF INCUBATION.—The period of incubation is the interval between exposure to infection and the appearance of the resulting disease. It is divided into two stages, those of *latency*, and of *invasion*; the one has reference to supposed changes in the infecting particles, the other to noticeable changes in the health of the person infected; the first stage is of variable duration and without definite symptoms, while in the second the disease is progressing and the patient is said to be sickening for it, its duration being nearly constant for each special disease. The division is not well-marked; there are changes in the so-called latent period which do not always escape detection, while those of the invasion have often to be considered as part of the disease. Where the latent stage is much prolonged a *dormant* period is inferred, for it is possible that infection may remain in the body for a time dormant; this term is only applicable to certain conditions under which infection is transmitted, and instead of speaking of the long intervals of inactivity at which epidemics recur as periods of latency or of incubation, it is to these periods of quiescence that the term dormant should be restricted.

The results of septic infection are manifested in the body without any true incubation.

Incubation properly refers only to the latent periods of infection in the acute specific diseases; still it is usual and often convenient to reckon the period of incubation as extending to the full development of the more characteristic signs of each of these diseases.

The duration of this period differs for different classes of infectious diseases, and in a less degree for each disease; it varies within certain limits for the same disease, but is sufficiently constant to afford some distinctive characters useful in diagnosis and a knowledge of which is essential to preventive medicine. The germs of all the incubative diseases are reproduced in the bodies of the sick; to stop infection the susceptible who have been exposed to it should not mix with others till the incubation-period has passed without signs of illness. Hence it is important to ascertain the laws regulating the incubation of each specific infection, and to define the limits of variation. The invasion-stage of all these diseases is already infectious.

1. *Variola* and *Vaccinia*.—In small-pox, after infection, the eruption occurs in fourteen days, and marked illness begins two days sooner. This is so well established as to afford a guide to the source of infection, by which it may frequently be discovered. Dr. Gregory's experience only furnishes one case in which the interval was prolonged to fifteen days. As short an interval as twelve days may be met with, though rarely, in small-pox modified by vaccination or by a previous attack. Small-pox by inoculation is developed in nine days; a local vesicle appears on the fourth day, there is glandular sympathy on the sixth, and febrile disturbance on the seventh and eighth days. Exactly this course is observed in vaccinia resulting from vaccination.

2. *Varicella*.—Chicken-pox has an uncertain incubation-period, varying from ten or twelve to fifteen or even nineteen days. The eruption begins with the first symptoms of illness.

3. *Morbilli*.—Measles has twelve days of incubation, reckoning to the appearance of the rash, or eight days from infection to the sickening; the latent period may be only four or six days, that of invasion may extend to six instead of four days. The general experience of schools and hospitals gives ten days from rash to rash, which is twelve days for incubation. Measles results from inoculation in seven or eight days; the shortest instance from infection, one of fifty cases traced by the writer, was eight days, the two longest, sixteen and eighteen days; but it may possibly extend to twenty-one days.

4. *Rötheln*.—Rötheln has an incubation-period of not less than ten to fourteen days, frequently extending to seventeen or twenty-one days. Very little illness precedes the rash.

5. *Mumps*.—Mumps usually takes from fourteen to twenty-one days for incubation; the shortest period is ten days; the longest that has come under the writer's observation was twenty-two days. Symptoms referable to the invasion-stage may be noticeable for a week before the swelling of the parotids; the latent stage may continue from eight days to twenty.

6. *Pertussis*.—This generally has one week, or even two, of incubation before the first febrile and catarrhal symptoms appear; there is often a latent period of only four or five days, as some cough may precede the fever; the distinctive cough is seldom heard till after the second week the shortest period in which it has been known to occur is eight days.

7. *Influenza*.—Influenza has a very short incubation-period, reckoned by hours.

8. *Scarlet Fever.*—Scarlet fever has a short incubation-period; from three to five or six days is the time in which the disease is usually declared; it may appear in less than two days; the longest interval is seven or eight days. There are instances where exposure to this infection has produced no effect until after some accident or surgical operation, the rash then appearing in from three to five days. Supposing infection to have been received a week previously, twelve days would not be too much to allow for such possible extension of the incubation-period. After removal from a source of scarlet fever, those who have no symptoms of the illness within one week will generally escape.

9. *Diphtheria.*—Diphtheria may be developed in three or four days; an interval of from six to eight days is not unfrequent. Sometimes two or three days' fever precedes the first local signs; or these may appear at the very commencement, and the incubation be reduced to a single day. On separating the healthy from the sick, more than a week must elapse before immunity can be predicated.

10. *Typhoid Fever.*—In enteric fever, the occurrence of the first symptoms in a large number of cases, traced by Buchanan, was eleven days after the operation of the cause, many other cases occurring two or three days later. Dr. Hunter of Linlithgow gives one case, with a single definite exposure, where the prodromata occurred in the early part of the third week with a rigor at the end of it, twenty-one days elapsing before the fever was marked; certain interruptions to the febrile process may still further prolong the interval. An incubation-period of only five days has been noted, once from contaminated milk, and once from infection; there are instances of an eight days' incubation when some of the poison has been inhaled.

11. *Typhus.*—Typhus has, in the great proportion of cases, twelve days of incubation. The late Dr. Murchison gives three cases that have exceeded this period by two or three days, and one of twenty-one days; ten of his cases fell short of it by two, six, or eight days; one of these did not exceed two days, and in two of them the latent period must have been a few hours only. The distinctive rash appears on the fourth or fifth day of illness.

12. *Relapsing Fever.*—This fever has five days of incubation; this exactly agrees with the life history of the *spirillum* observed in the blood during the fever; the incubation-period may, however, be prolonged to seven, nine, or twelve days, or shortened to two days; many cases have succeeded almost immediately on exposure to a concentrated infection.

13. *Plague.*—Plague is communicated in from two to five days; the fever may commence on the first day, the glandular swellings on the third, or sometimes glandular tenderness begins with the fever. A period of four days suffices to set up the constitutional symptoms when the plague is conveyed by inoculation.

14. *Yellow Fever.*—Yellow fever has a short incubation of from two to six days, rarely exceeding eight days. Dr. Cargill of Jamaica gives a case fatal the day after exposure to infection.

15. *Dengue.*—Dengue is quickly developed, usually in three days. The febrile ingress is sudden, and precedes the rash only by a few hours.

16. *Cholera.*—Incubation in cholera lasts from a few hours to four days. The reports of numerous commissions give from one to five days; within five days, before the third, and not later than the fourth day. Individual cases often fall on the second or third day; the premonitory diarrhœa should be considered as part of the disease.

17. *Malaria.*—The infection of true malaria is not given off by the bodies of the sick, but limited to certain localities. This kind of miasm, to which the term infection is sometimes improperly restricted, has a marked period of incubation, which is often a lengthened one. The non-contagious malarious fevers of the West Coast of Africa often show an incubation-period of ten to twelve days. In July, 1810, our troops in Sicily fell ill with remittent fever thirteen or fourteen days after exposure to malaria. Men continued to fall ill for twelve days after their removal from the infected site. Labourers going to our fen-districts for the harvest seldom had ague till the end of their month's work, and often not till two or three weeks after their return. Ague may not appear till months after residence in a marshy district.

18. *Syphilis.*—The induration of a syphilitic sore appears after ten days; six weeks later the rash or sore throat. The localised changes of the initiatory period may occupy from three days to three weeks or even longer; in the shortest instances with immediate adenopathy the eruption follows in six weeks. John Hunter gives the interval from the local to general infection as two months; this may extend to eighty days. Other constitutional symptoms occur at much longer intervals. The contagion of secondary syphilis requires five weeks or longer to become manifest.

19. *Rabies.*—Hydrophobia presents us with the longest, and also with the most variable period of incubation; this, however, has a limit of great practical value; the shortest interval known is a fortnight, so that ill effects felt in a less time than this, or following rapidly after the bite, are readily distinguished from rabies. The usual period of incubation is six weeks. Three weeks is an exceptionally short period, three months not exceptionally long. Dr. Mead gives cases occurring after eleven and fifteen months. An interval of thirteen years has recently been recorded. After the second month has elapsed the fear of any ulterior consequences becomes less and less. In the dog the usual interval is from three to six or eight weeks; it has occurred after three months, and in one instance recorded by Youatt after seven months. The shortest interval given by Regnault, from the bite to signs of rabies in the dog, is ten days; of his sixty-eight cases ten were from a fortnight to three weeks, and fifty-seven at longer intervals.

The incubation-periods of these widely-differing diseases, while retaining distinctive differences, merge into each other. The longest intervals observed for scarlet fever and diphtheria correspond with the shortest observed in measles and small-pox, while the longest in these diseases

and in mumps come near the shortest period for hydrophobia or ague. Many important diseases are separated widely and distinctly by their length of incubation, as small-pox from cholera, yellow fever and plague from typhus, and still more widely from the recurrent paludal fevers.

WILLIAM SQUIRE.

INDIAN RINGWORM. *See* EPIPHYTIC SKIN-DISEASES.

INDICATION (*indico*, I point out).—That which suggests or clearly demonstrates the course to be pursued, and the remedies to be adopted by the practitioner, either for the prevention, or in the actual treatment of disease.

INDIGESTION.—Difficulty in digestion. *See* DIGESTION, Disorders of.

INDURATED CHANCRE.—A synonym for hard chancre. *See* SYPHILIS.

INDURATION (*induro*, I harden).—A term applied to the process or condition of hardening of the tissues from any cause.

INFANTILE CONVULSIONS. — *See* CONVULSIONS; and INFANTS, Diseases of.

INFANTILE PARALYSIS. — SYNON.: Fr. *Paralysie essentielle de l'enfance* (Laborde); *Paralysie atrophique graisseuse de l'enfance* (Duchenne); Ger. *Kinderlähmung*.

ÆTIOLOGY.—This is a disease which affects children at an age varying from a few months to a few years, and commonly during the first dentition. Antecedent events, such as falls, injuries, and dentition, have been assigned, but on no sufficient evidence, as causes of this lesion; and beyond the fact that infancy is a distinct predisposing cause, almost nothing is positively known in regard to the ætiology of this affection. Its onset is often quite sudden, in the midst of what appears to be perfect health.

ANATOMICAL CHARACTERS.—Recent microscopical investigation of the spinal cord and muscles has thrown much light on the morbid anatomy of infantile paralysis. In most cases the atrophied muscles are found to have undergone fatty degeneration, with disappearance, to a greater or less extent, of the transverse striæ. Oil-globules and numerous fat-cells are also found between the fibres.

It has been shown by the investigations of Cornil, Prévost and Vulpian, Charcot and Joffroy, and the writer, that in fatal cases of infantile paralysis the spinal cord and its nerves are affected by a variety of lesions. These morbid changes consist of atrophy of the anterior cornua and their nerve-cells; of granular disintegration and atrophy of the anterior nerve-roots; and of atrophy of the anterior columns, particularly in the cervical and lumbar enlargements, where the nerves that supply the atrophied limbs are given off. Corpora amylacea have also been found both in the white and grey substances.

SYMPTOMS.—Infantile paralysis is usually preceded by pyrexia, and more or less pain in the back. The attack is generally sudden, and sometimes is accompanied by convulsions, which are at once followed by paralysis, but without loss of sensibility. The lower extremities are generally the first invaded, and the paralysis rarely attacks the upper extremities alone. In the beginning it is more or less generalized, but after a time it becomes limited to groups of muscles, to particular muscles, or to one member. The muscles most prone to be affected are those at the anterior part of the leg—the extensors of the toes, and the flexors of the foot; the extensors and supinators of the hand; the extensors of the leg; and the muscles of the foot. In some instances the disease fixes on single muscles, particularly the extensor longus digitorum pedis, the tibialis anticus, the sterno-mastoid, or the deltoid. There is a loss of five or more degrees of temperature in the parts affected; and their reflex excitability, as well as their electric contractility, is more or less diminished, and sometimes completely abolished. After a period varying from one to two or more months, the paralysed muscles begin to waste. This wasting is much more rapid than in progressive muscular atrophy, and is in proportion to the loss of electro-muscular contractility. Bones and ligaments are also often involved in the atrophy.

After a period, varying from a few days to a few weeks, those muscles of which the structure has remained unaltered may recover their voluntary contractility, and then the paralysis disappears; but this period is sometimes more protracted. In those which regain their voluntary and electric contractility, nutrition improves, and their volume increases; whereas those muscles which remain paralysed undergo progressive atrophy, accompanied by granular or fatty degeneration. The tonic force of those muscles, therefore, which have preserved or have recovered their contractile power, not being opposed by their antagonists, which have undergone atrophy and degeneration, a variety of deformities and unnatural attitudes gradually ensue, and call for the skill of the surgeon. The most important of these club-foot deformities are *talipes equinus*, *equino-varus*, *equino-valgus*, *calcaneus* or *calcanes-valgus*, and *varus*.

PROGNOSIS.—This will depend on the nature and extent of the morbid changes that have taken place in the nervous centres and in the muscles. The extent of these changes can be surmised by the electro-muscular test. Just in proportion as a paralysed muscle loses its electro-muscular contractility and sensibility does it undergo atrophy, and subsequently pass rapidly into a state of granular or fatty degeneration. If, therefore, the electric contractility of the affected muscles be lost to the induced and continuous current, the prognosis will be of the gravest character.

TREATMENT.—In the treatment of this disease both general and local means must be adopted. In the acute stage, rest in the recumbent posture is of great importance. When the muscles have become affected by paralysis and atrophy, local as well as general means of treatment must be employed. Of the local means electricity is one of the most important. If the induced current should fail to produce contraction of the affected muscles, the continuous current should be employed. Shampooing, friction, and the application of hot water to the muscles are also useful. The subcutaneous injection of mi-

nute quantities of strychnia the writer has used with great advantage in several cases. At the onset of the paralysis he decidedly recommends a repetition of blisters to that portion of the spine from which the nerves supplying the affected muscles proceed.

In the later stages of the disease, when it is manifested chiefly by paralysis and atrophy of muscles, the most approved general remedies consist of strychnine, cod-liver oil, the preparations of cinchona and iron, arsenic and phosphorus, together with attention to the secretions and excretions, and to ordinary hygienic measures. J. Lockhart Clarke.

INFANTILE REMITTENT FEVER. By some authorities a disease thus named has been regarded as a special kind of fever; but the condition is probably either typhoid fever of a mild type, or febrile disturbance accompanying disorders of the alimentary canal.

INFANTS, Diseases of.—There are few disorders which can be said to be peculiar to infancy and childhood. The diseases to which children are liable are, as a rule, those which attack older persons, and present the same pathological characters. But disease as it occurs in children does yet require especial study, for the symptoms by which it is accompanied often differ widely from those with which ordinary hospital practice has rendered us familiar. Children are not merely adults in miniature. They have special peculiarities of constitution, which impress their own stamp upon all acute diseases, and often raise up a number of accessory phenomena which overshadow the main symptoms, and obscure a case which but for them would be simple and clear.

General Characters.—The most striking peculiarity of childhood is the marked excitability of the nervous system; for the promptness and intensity with which the whole system reacts against any source of irritation is a cause of continual embarrassment to the physician. A fragment of indigestible food, for example, may produce high fever, or alarming agitation, and even throw the child into convulsions: a slight irritation of the larynx may produce severe spasm, and simulate for the time all the symptoms of true diphtheritic croup. The beginning of acute disease is almost invariably accompanied by profound general disturbance; but disturbance as profound may be excited by the simplest functional disorder, so that the severity of the symptoms is no guide at all to the severity of the lesion with which we have to deal. In all cases, therefore, it is of importance, if possible, to pick out the local symptoms—those, namely, which point to mischief of any special organ—and separate them from others which are expressive merely of the general distress. Such local symptoms are the cough, rapid breathing, and active nares which point to acute lung-disease; the squinting and immobility of pupils which are so characteristic of cerebral affections; and the peculiar jerking movement of the legs which, combined with hardness of the abdominal muscles, betrays the existence of colicky pain. Such local symptoms are not, however, always to be discovered, and even if present may not furnish trustworthy indications; for so great is the sympathy in the young child of distant organs with one another—linked together as they are by the impressionable nervous system—that the organ from which the more definite symptoms appear to arise, may not be the organ which is actually the seat of disease. The two organs which are most frequently found to present these deceptive manifestations are the stomach and the brain. The sympathy of the stomach with an irritable condition of other parts of the body continues more or less through life: the vomiting of pregnancy and of disordered uterine function in the female, and of cerebral and renal diseases in both sexes, being matter of common observation. In the child, however, this sympathy is carried to its highest point. Vomiting is a common symptom at the beginning of every acute disease, and in many children any casual disturbance is apt to be attended by it. The brain, again, exhibits a close sympathy with irritation of the more important organs. In some cases of pneumonia, notably those where the inflammation is seated at the apex of the lung, headache, vertigo, delirium, and stupor may be so marked that the ordinary symptoms of the disease are completely obscured, and the case is mistaken for one of meningitis. Again, the violent nocturnal delirium so often excited by the irritation of worms in the alimentary canal, must be within the experience of all.

The nervous excitability of children, and its influence upon the system generally, is well illustrated by the high temperature noticed in many children on the first evening after admission into the wards of a hospital. The elevation varies in degree in different children; but if the patient be not a mere infant, it is usually over 100°. although the complaint be one not ordinarily attended by pyrexia.

Perhaps, however, the most familiar instance of the impressibility of the nervous system is seen in the case of convulsions. A 'fit' in the child has a very different meaning to a similar attack in the adult. In the latter it is usually evidence of a grave centric lesion, and its occurrence occasions the greatest anxiety. In the child, on the contrary, it is a common expression of the perturbation of the nervous system, set up in response to some excentric irritation, and often, as in the case of the onset of acute disease, is analogous to the rigor which ushers in an acute attack in older persons. Sometimes, it is true, convulsions are produced in the child, as in the adult, by severe cerebral disease; but in such cases the fits are frequently repeated, and are succeeded by rigidity, paralysis, and other signs of centric irritation. As a rule, single fits, or convulsions occurring without other signs of nerve-lesion in a healthy child, are purely reflex, and have no gravity whatever.

The impressibility of the nervous system is increased by causes which produce a sudden depression of strength, such as a bad attack of diarrhœa, or loss of blood, and in one chronic disease—rickets—the nervous irritability is very great. The effect of chronic wasting upon the child is, however, usually to produce an opposite result; and under the long-continued influence of enfeebling disease the excitability of the ner-

vous system becomes gradually less and less manifest, until it finally disappears almost entirely. It is of importance to the practitioner to bear this fact in mind, for in a child much reduced by chronic illness, the presence of an intercurrent acute complication—such as inflammation of the lung—may be indicated by very few symptoms, the system having become almost insensible to nervous impressions.

Another peculiarity, which strikes the attention of anyone accustomed only to disease as it occurs in the adult, is the vast preponderance in infantile disorders of mere disturbance of function, and the disastrous consequences which may ensue from such derangements. Infants rapidly part with their heat, and are easily chilled. They are therefore excessively sensitive to changes of temperature. A catarrh is a common ailment in the young child, and is attended by various dangers according to the part of the mucous tract which is affected by it. Gastric catarrh with violent and repeated vomiting, and intestinal catarrh with uncontrollable diarrhœa, are answerable for a large proportion of the deaths amongst young children during the warmer months. Even in cases where the catarrh affecting the digestive organs is of a less acute and violent character, the issue is often very serious. The gradual failure in nutrition, which is the result of such an impediment to the digestion of food, is a common cause of wasting in young children; and unless measures be taken early to restore the proper working of the alimentary functions, the case may end fatally. In the autumn and winter the bronchial mucous membrane is more frequently attacked. In such cases, however apparently slight may be the catarrh, a weakly infant is always exposed to the danger of pulmonary collapse; and a rapid interference with the respiratory function, such as takes place when collapse of some extent of lung is quickly brought about, is often a cause of sudden death.

It is in consequence of this frequency of functional derangements, and their dangerous character, that *post-mortem* examinations in infants are so often unsatisfactory in finding any appearances explanatory of the cause of death.

Clinical Examination.—The clinical examination of young children requires tact and patience, but unless the child be very unruly it is not difficult. The patient cannot himself describe his symptoms, but all necessary information can be gained from the parents. Mothers are, as a rule, good observers, and allowing for their natural anxiety and a slight tendency to exaggeration, their statements can usually be relied upon. We can thus learn the previous state of the child, the exact date at which his symptoms began, and the order in which they appeared. Infants should be always stripped for examination, so that the whole body may be exposed to view. Before, however, ordering the removal of the clothes, we should be careful to satisfy ourselves upon certain points which can only be properly observed while the child is in repose. Thus, in order to count the pulse and respiration, perfect quiet is indispensable, for the least movement quickens the heart's action, and alters the rapidity of the breathing. At the same time the temperature can be taken by the thermometer in the rectum. The whole body should then be examined for spots or swellings; the condition of the skin can be noted—whether dry or moist; and we can ascertain the state of the belly, with regard to hardness or softness of the abdominal walls, and the size of the liver and spleen. If the child cry at the time, we mark the character of the voice, for hoarseness is an early sign of congenital syphilis.

In the physical examination of the chest in a child, it is important to attend to the following points:—To employ percussion of the two sides at the same period of the respiratory movement, that is, during expiration or during inspiration; to strike gently with *two* fingers, for by this means a larger volume of sound is brought out, and slight dulness is more easily detected; always to use a stethoscope instead of the unassisted ear, in order to limit the area listened to; and to manage so that the child's mouth be open during auscultation, so as to hinder the transmission of sounds from the throat. In an infant the back is best examined by placing the child on the nurse's left shoulder, with his left arm round her neck. If the chin be now depressed by the nurse's hand on the child's head, the muscles of both shoulders are relaxed. The front and sides of the chest can be examined as the infant lies on his back. We must remember that the breath-sounds, especially that of inspiration, are of a more blowing quality in the child than they are in the adult; and that there is naturally less resonance at the right base, on account of the proportionately greater size of the liver.

At the end of the examination the mouth should be looked at for signs of aphthæ or thrush; and the condition of the gums, as to heat and swelling, should be ascertained. Lastly, the throat is to be inspected—depressing the tongue with the handle of a spoon. If there be disorder of the digestive apparatus, such as sickness, constipation, or diarrhœa, it must not be forgotten to examine always and carefully the discharges. The urine should not be overlooked.

Diagnosis.—Diagnosis in the young child is sometimes very difficult, but it is often easy enough. Being aware of the nervous excitability in young subjects, we are prepared for evidences of general disturbance, and look for more special symptoms—such as will indicate local distress, and direct our attention to a particular organ. We are also guided by a history of the attack, as gathered from the mother, and can put our suspicions to the test by a careful exploration of the whole body. In the investigation our general knowledge of the course of disease will be of service. Thus, many disorders have known pathological consequences, and are apt to be followed by special sequelæ. Measles and hooping-cough leave behind them a tendency to catarrhal pneumonia, and a liability to tuberculosis. Scarlatina often leads to acute desquamative nephritis and dropsy. Other diseases again encourage particular susceptibilities—as rickets, which renders the body exceptionably sensitive to changes of temperature, and provokes catarrhal derangements. In doubtful cases we must not forget to take prevailing epidemics into account, as the beginning of zymotic diseases is often excessively puzzling. In all cases, especially

if the patient be an infant, it is important to inquire into the hygienic and dietetic arrangements to which the child is subjected. When we are still undecided, after having exhausted all means of investigation, we must be contented to wait for further indications, and no positive opinion should be hazarded while any doubt remains.

Treatment.—Children, as a rule, respond well to treatment. This may be explained partly by the large proportion of mere functional derangements in the illnesses to which they are subject, and partly by the state of constant change through which the body is passing; growth and development are active in organs, and the tendency is to repair. The term treatment, however, includes far more than the mere giving of physic. A complete change in all the influences acting upon the patient—a reconstruction of the dietary, and a reformation in the hygienic arrangements, especially with regard to air, light, and clothing—will often prove of immense service, and be of far more value than actual drug-giving in furthering the recovery of the child.

In the treatment of acute illness we must remember that young children cannot bear lowering measures; but we must not therefore rush to the opposite extreme, for unless suffering from temporary exhaustion, they are far from being benefited by profuse stimulation. In the beginning of acute inflammatory diseases stimulants are injurious. Even in chronic ailments, such as rickets, where a certain amount of alcohol is often of service, wine should be given with caution, and its effects upon the digestion carefully watched; it can only be given with advantage so long as it improves the appetite, and increases the digestive power.

With regard to medicines little need be said in this place. It may be remarked that, on account of the tendency to acid dyspepsia in all children, alkalies are of especial service; and that they should be always combined with an aromatic, on account of the value of the latter in stimulating the alimentary mucous membrane, and relieving the flatulence and other painful consequences of indigestion. It is important also to remember that children are wonderfully tolerant of certain drugs, while they bear others very badly. Belladonna may be given to infants and children in very large doses. They are also more tolerant of arsenic than their elders. To the action of opium, however, they are excessively susceptible, and the drug should be given—to infants especially—with extreme caution.

Eustace Smith.

INFARCT (*infarcio*, I cram in).—This term was formerly applied to any kind of infiltration of an organ; but its use is now almost confined to the expression *hæmorrhagic infarct*. A hæmorrhagic infarct is a firm, red, usually wedge-shaped patch, which is found in certain organs as the effect of arterial embolism, or, more immediately, of the congestion and extravasation of blood to which the embolism gives rise. *See* Embolism.

INFECTION
INFECTIOUS } (*inficio*, I stain).—There
INFECTIVE }

is much ambiguity and want of precision in the application of these terms, and it is only intended here to attempt to define them according to their several uses, the reader being referred for fuller illustration to the appropriate articles. Usually, they are coupled with diseases which are known to be capable of transmission from one animal to another of a different class, or from one individual to another of the same species. In general language such diseases are said to be *infectious*, and to be conveyed by *infection*. These words are, however, often employed in a more definite and limited sense, as signifying the transmission of affections of this kind without the necessity of any direct contact between the individuals, or of any obvious application of the morbific agent to the body, or its immediate introduction into the system, this agent being conveyed through the atmosphere, and taken in mainly by respiration. This limited meaning is employed in contradistinction to *contagion* and *contagious*, which then imply direct contact, and to *inoculation*; in this sense some affections being regarded as infectious but not contagious, and *vice versâ*. The word *infection* is sometimes used as synonymous with the *contagium* or agent by which a communicable disease is conveyed. An important application of the term *infective* is that in relation to the effects resulting from certain morbid products, which have been made evident during recent years, mainly by the investigations carried on in experimental pathology. Thus it has been found that the introduction of tubercle subcutaneously will lead to the formation of a similar product in different organs of the body; and the same result may follow mere suppuration under certain conditions, as well as the accumulation in the body of caseous material. The morbid products are absorbed, and originate tuberculosis by an infective process. It is even maintained that tuberculosis may be produced in this way by merely introducing tuberculous material into the stomach, as in the form of diseased meat. Again, the inoculation of septic matter has been proved to cause septicæmia and pyæmia by a similar process. When certain morbid conditions have been established within the system, other parts, more or less distant from the primary seat of mischief, often become involved by infection within the body itself, in consequence of the products being conveyed by the blood vessels or lymphatics to these remote parts, and there undergoing further multiplication and growth. Indeed the whole system may thus become tainted, including the blood and other fluids. Illustrations of this signification of infection are afforded by cancer, syphilis, tuberculosis, and suppuration, the last-mentioned not only being liable to originate secondary collections of pus, but also being the usual cause of pyæmia. *See* Contagion.

Frederick T. Roberts.

INFILTRATION (*in*, into, and *filtro*, I filter).—This term was formerly applied to the effusion of a fluid into the interstices of a tissue, especially connective tissue. Now, however, its

meaning has been extended to imply the diffusion of any solid or fluid morbid product in the midst of tissue-elements, such as is seen in calcareous, albuminoid, fatty, and tubercular infiltration. *See* DEGENERATION.

INFLAMMATION (*inflammo*, I set on fire). SYNON.: Fr. *Inflammation*; Ger. *Entzündung*.

DEFINITION.—Very numerous definitions have been given of inflammation. The most generally received has been that attributed to Celsus, which gives the four marks of inflammation as *rubor, tumor, calor, dolor*; but this appears to have been really due to Erasistratus, who, according to Galen, first gave precision to the conception of simple burning, as understood by the older Greek physicians, and applied the name φλεγμονὴ (previously synonymous with φλόγωσις) to a swelling, which had also the characters of heat, pain, throbbing, and resistance. The definition was thus based upon the notion of *swelling*, and would hardly have taken this particular form had it been derived from superficial inflammations. Although the four 'cardinal' signs may still be recognised in what we call inflammation, the definition is best derived from a cause known to be capable of producing it, and we say that *inflammation is a series of changes in a part identical with those which are produced in the same part by injury*; and, for the sake of precision, *injury by a chemical or physical irritant*. The most evident result of a slight and temporary irritation is, in vascular parts, hyperæmia, and inflammation may be regarded as produced by a more intense action of the same cause as produces simple hyperæmia; but it is not, as formerly said, a kind of, or a further degree of, hyperæmia. The minute study of inflammation is best conducted by continuous observation on transparent parts of animals seen under the microscope, especially the mesentery and tongue of the frog. No non-vascular part is equally available for continuous observation in a living state, but by special methods the process may be followed in the frog's cornea.

DESCRIPTION OF THE PROCESS IN VASCULAR PARTS.—When the mesentery or tongue of a frog is drawn out and placed under the microscope, the contact of the air soon determines inflammation; and by means which need not here be described, both the vessels and the tissue-elements may be observed for hours together. The earliest change seen in the vessels of a part thus exposed is dilatation, first of the arteries, then of the veins, the capillaries being little affected. The dilatation of the vessels is accompanied at first by acceleration of the blood-stream, most noticeable in the arteries; but the acceleration does not last more than half an hour or an hour, and it then gives place to retardation, which continues as long as the inflammation lasts. The 'primary acceleration' is, however, sometimes absent or too short in its duration to be noticeable. So far, the process is doubtless the same as in active hyperæmia produced by local irritation. Whether the first dilatation is due to direct paralysis of the muscular walls of the arteries, or to a reflex action passing through the spinal cord, or to an inhibitory action passing through nerve-ganglia in the arterial walls, is uncertain. There need not, however, be any reflex action through the spinal cord, as dilatation may take place when the part is disconnected from the great nerve-centres.

From this point begin the phenomena peculiar to inflammation. The dilatation of arteries may go on increasing for ten or twelve hours, till these have double their original diameter, and pulsation becomes very prominent in them. The capillaries look as if gorged with corpuscles, forming a quasi-solid mass. The blood-current in all the vessels becomes slower and slower, till it is almost stagnant. This condition is known as *stasis*. At the same time certain peculiarities are observed in the behaviour of the red corpuscles and leucocytes in the veins. In ordinary conditions of the circulation, the central part only of the vein (as of the artery) is occupied by the corpuscles, which move on mingled together. But during *stasis* the corpuscles, especially the leucocytes, spread over the marginal portion of the vein usually free from them, and the leucocytes begin to drag along the walls of the vein, as if adherent, till at length they form a layer lining the wall of the vessel, while the red corpuscles are carried on by the current. In the capillaries, this marginal layer is never perfectly established, though leucocytes may be seen momentarily adhering to, or moving slowly along the walls. In the arteries, no such process is observed, except (according to Cohnheim) it may be for a moment during the diastole of the pulse. When this *marginal position* of leucocytes is established, and the *stasis* is at its height, begins the process which, observed long ago by Waller, and less clearly though earlier by William Addison, was re-observed and brought into notice by Cohnheim. In the words of the last-named observer: 'On the outer contour of the wall of a vessel, usually a vein, in which the marginal layer of leucocytes is well developed, sometimes first in a capillary, is seen a small projection which enlarges in length and breadth, and becomes a roundish colourless lump. This again enlarges, puts out new pointed projections, and gradually withdraws itself from the wall of the vessel, till it is attached to it only by a long narrow stem. Finally this attachment also is broken, and we see a colourless contractile body with one long process and several shorter, with one or several nuclei, in fact, a *leucocyte*.' The same process is going on meanwhile at other points of the veins and capillaries, till at length, either quickly or slowly, the outer surface of all the visible veins becomes covered with several rows of leucocytes, while their interior shows the same appearance as before. That the leucocytes seen outside were formerly inside the veins, having simply passed through the walls, admits of no reasonable doubt, though it is often difficult for the eye to seize the precise moment of passage. In the arteries nothing of the kind is seen. In the capillaries the emigration of leucocytes is very evident, and accompanied by the passage of red corpuscles also through the walls, which does not take place in the veins proper. The latter process was observed by Stricker before the revival of the observation of emigration of leucocytes.

Accompanying the extravasation of the blood-corpuscles, there is always a copious exudation

of serum, which goes far beyond physiological limits. Aided by this and by their own spontaneous movements, the leucocytes are carried far and wide into the tissue, till the whole field, that is, the whole mesentery, is so crowded with them, that nothing else can be seen. The red corpuscles, on the other hand, remain more closely in the neighbourhood of the vessels. When the exudation, carrying with it the corpuscles, and containing, as it does, coagulable material, reaches the surface, it forms the layer or false membrane of inflammatory lymph, seen in inflammations of serous surfaces.

Cause of stasis and cell-emigration. — The processes just described mark inflammation off sharply from simple hyperæmia. The production of stasis was at one time ascribed to thickening of the blood from transudation of serum; also to coagulation in the vessels; to the adhesiveness of leucocytes; and to a change in the tissues external to the vessels. But there is little doubt that the essential factor is a change in the constitution of the vascular wall, though it is still possible that this may be connected with a change in the tissues outside. The same change, while it retards the passage of blood, makes the vascular wall permeable to the corpuscles, and favours exudation. What the change is we cannot say, but it seems probable that it is the same as the walls of vessels undergo when inadequately nourished. Two classes of experiments throw light on this point.

It has been found by Ryneck that other fluids than blood, such as milk, pass with greater difficulty than usual through the vessels of an irritated part; and that stasis can be produced in the vessels of a frog, which is kept alive by the circulation of salt-solution instead of blood in its vessels. Cohnheim has also shown that a state of the vascular walls similar to that which may be presumed to exist in inflammation, may be produced by shutting off the blood from the vessels for a certain time. He put a ligature round the tongue of a frog, and observed the vessels after the ligature was cut. If the blood had been excluded for twelve to twenty-four hours only, the vessels on the return of the blood passed into a condition of simple hyperæmia; but if longer, stagnation, marginal position of leucocytes, and extravasation of corpuscles were observed, and these phenomena were more marked the longer the ligature had remained, provided it was not long enough entirely to destroy the vitality of the part. From these experiments we must conclude that the cause of stasis and its attendant phenomena is not in the blood or the cells, but in the walls of the vessels, and that the change in these is of the nature of degeneration.

Changes of the tissue-elements.—These changes are most simply seen in non-vascular parts, which will be first considered. Alterations in cartilage-cells during ulceration were observed long ago by Goodsir and Redfern, but were not then thought to belong to inflammation, non-vascular parts being not thought liable to this process. Lately the cornea has been taken as the type of non-vascular tissues. If the cornea of a frog be irritated by touching a small spot with nitrate of silver, and cut out within from twelve to twenty-four hours afterwards, many of the fixed corpuscles are found to be already altered. Their processes are become shorter and thicker; their bodies of irregular shape; and they often show amœboid movements, and become converted into many-nucleated protoplasmic masses, resembling what are in some other parts called giant-cells. Finally, in their place may be seen groups of new cells, or pus-corpuscles. But there are always some corneal corpuscles which remain quite unchanged. These changes cannot be traced farther, as the cornea soon becomes turbid, and the whole field of observation crowded with leucocytes.

It is still a matter of dispute whether these changes are truly reproductive or only degenerative; and whether any new cells are really formed from the fixed pus-corpuscles of the cornea, or whether the origin of these leucocytes is the same as of those which are seen surrounding the veins and capillaries of the inflamed frog's mesentery. On the one hand, it is said that the cornea can be excised so early as to preclude the possibility of migratory corpuscles finding their way from the vessels surrounding the cornea, and that even then groups of leucocytes are found in the place of corneal corpuscles, which must have been produced by germination from them. On the other hand it is urged that, even supposing it impossible that these cells could come from the surrounding blood-vessels, the conjunctival lymph-sac contains lymph-corpuscles which might travel into the cornea. Further, the leucocytes of the blood have been coloured by injecting colouring matter into the veins, which the leucocytes take up, and cells thus marked are found among those supposed to be derived from the corneal corpuscles. Without discussing these conflicting arguments, we may say that we believe the truth to be this: that young cells, undistinguishable from leucocytes or pus-corpuscles, are formed by a process of growth, cell-division, and germination, affecting the fixed corneal corpuscles, but that the number of these is inconsiderable compared with those which, even in a non-vascular tissue like the cornea, are derived from the vessels.

The process of inflammation in other non-vascular parts, such as cartilage, has been studied in the same way as in the cornea, in all cases with the disadvantage that continuous observation is impossible. The general result is the same, namely, that changes are seen, apparently without any participation of the vessels, which are regarded by some as showing degeneration and breaking up of the fixed tissue-elements; by others as showing germination and formation of new cells, but which in any case do not play an important part in the whole inflammatory process.

Tissue-changes in vascular parts.— These, though apparently more ambiguous than in non-vascular parts, are yet sometimes susceptible of more minute study. In the omentum of mammalia, changes occur during inflammation in which unbiassed observation can hardly see anything else than cell-division, growth, and germination. There is indeed reason to believe that such appearances are found normally, as evidence merely of growth, but the inflammatory changes

are distinguished from the normal by their greater frequency and luxuriance. In fibrous connective-tissue similar processes have long been observed, and since attention was drawn to them by Virchow, have been regarded till lately as showing, in the clearest manner, that the fixed cells of the tissue germinate and produce new elements. This 'proliferation of connective tissue' was regarded, especially by German pathologists, as an obvious fact, and as the explanation of many morbid processes. But it is now known that what were regarded as connective-tissue corpuscles are really spaces, which may become filled with leucocytes migrated from neighbouring blood-vessels, and when the cells proper can be seen, the latter are often unaltered. Around inflamed parts the connective-tissue is often found infiltrated with young cells, the origin of which was formerly set down to proliferation. But it seems more simple to regard this 'small-celled infiltration,' which is a very frequent accompaniment of inflammation, as resulting from migration of leucocytes from the veins and capillaries of the inflamed part. The possibility, however, of 'connective-tissue proliferation' cannot be doubted; and, if it occurs, the number of elements thus produced will not, as in the case of non-vascular parts, be necessarily limited. With respect to other tissues, such as muscle, nerve, &c., very conflicting statements have been published. Some years ago numerous observations were made, supposed to show the formation of new cells from the connective-tissue stroma of inflamed parts; it was then supposed that more specialised elements, such as muscle-fibre, epithelium, &c., could not produce the same; afterwards the same appearances were seen in these tissues, and interpreted in the sense which has been explained above. The recent observations of Stricker and his pupils tend to show that the tissues take part in the formation of pus-corpuscles, in true suppuration if not in lower degrees of inflammation, but do not, we think, materially alter the views to be derived from a direct study of the inflammatory process.

Besides the twofold origin of new cells above indicated, there is reason to believe that the leucocytes emigrated from the vessels, and perhaps those produced from the tissues, further divide and 'proliferate.' Stricker and Klein have both observed actual cell-division take place under the microscope; so that some of the new cells are regarded as the descendants of emigrated corpuscles. We may compare the new cells of inflamed parts to the population of a colony, where most are emigrants, or the descendants of emigrants, but some few trace their descent from the aboriginal inhabitants.

Beyond the production of new cells, the tissues outside the vessels cannot be said to play an active part in inflammation. Their passive changes are, however, important. These are chiefly degenerative, that is, necrosis of the elements takes place, preceded by various kinds of degeneration. Connective-tissue fibres soften; muscular fibres undergo fatty degeneration; and epithelium also wastes by means of fatty degeneration, and on surfaces is shed off. Nerve-tissue and all special tissues soften, liquefy, and disappear. In places where there is a large collection of pus-corpuscles, all tissue-elements become absorbed, and the *débris* is either carried away by the lymphatics and veins, or becomes mingled with pus. In fact, along with nutritive and germinative processes, there are destructive and atrophic processes equally active.

We must now consider the products and results of inflammation, without further distinguishing between the share of the vessels and of the tissues.

Products and Results.—All inflammatory products result either from exudation (with or without participation of the tissues), or from new growth. The exudative products are serum, mucus, and fibrin; which by combination with leucocytes, form inflammatory lymph and pus. New growth takes place from the vessels in the form of vascular connective tissue, of which a special form are granulations. With regard to exudations, no clear line can be drawn, at any stage of the process, between serous and fibrinous exudations, inflammatory lymph, and pus; the differences being only of degree.

Exudations.—Serous and mucous exudations can only when excessive be regarded as products of inflammation. The fluids formed in inflammations of serous cavities differ from those produced in passive exudations (or dropsies), in containing more fibrin and more albumen. But inflammatory exudations vary in this respect, and are sometimes scarcely to be distinguished from simple serous effusions. The fluids poured out on serous surfaces in acute inflammation always coagulate, and even in chronic cases can often be shown to be capable of coagulation. On mucous surfaces, on the contrary, the exudation does not as a rule coagulate. That this is owing in some way to the action of the epithelium seems most probable, whether it is that filtration through epithelium alters the composition of the fluid, or whether the living epithelium prevents coagulation in the same way as the endothelium of the vessels prevents coagulation of the circulating blood. When, however, the epithelium is removed, a fibrinous layer may be produced on the mucous surface; and the same result seems to follow the application of very powerful irritants, as in croupous inflammations. Mucous exudations contain mucin, as well as serum-albumen, in variable proportions.

Fibrinous exudations, in coagulating, entangle whatever leucocytes may be either extruded with the exudation, or present in the tissues. The properties of the coagulated mass differ according to the proportion of corpuscles. Hence it was at one time usual to distinguish *fibrinous* from *corpuscular* lymph, or even to regard fibrin as a mixed substance, partly made up of corpuscles. It is now known that these differences do not show any corresponding differences in the composition of the blood, but depend upon the facility with which the corpuscles leave the vessels. The product called *inflammatory lymph* consists of coagulated fibrin entangling leucocytes, the two constituents being in varying proportions. The fibrin does not differ from that of blood-clot; and may therefore be formed in the same way by a reaction between the exuded constituents of blood. But it is not a constant product of inflammation, and hence has been thought

to owe its production to local causes—that is, to reaction between the tissues and the exudation. Thus fibrin is formed on serous surfaces where normally one of the fibrin constituents is found, and for the same reason, in connective tissue; but, as stated above, not generally, on inflamed mucous surfaces, or in epithelial structures. But since it is possible that in these cases the exudation becomes altered by filtration through the tissues, there is no reason to doubt that fibrin, or both its chemical constituents, may be exuded from the vessels. Formerly great importance was attached to this product of inflammation. It was regarded as capable of forming, by organisation, new tissues; and by degeneration, pus and other things. But it is quite uncertain whether lymph is ever, strictly speaking, organised into tissue, and the formation of pus must be considered as differing from that of ordinary lymph only in degree.

Pus.—Pus is inflammatory exudation in which the corpuscles greatly predominate, and the intermediate substance is liquid. It is thus difficult to draw a line between pus and softer forms of inflammatory lymph, but the former does not contain fibrin, nor does it coagulate spontaneously. The following analysis of pus may be taken as representing an average specimen:—

Water	887·6
Pus-cells and mucus . .	46·5
Albumen	43·8
Fat and cholesterin . .	10·9
Sodium-chloride . . .	5·9
Other alkaline salts . .	3·2
Earthy phosphates and iron .	2·1
	1000·0

It is noticeable that pus contains a much larger proportion of fat than any other inflammatory products, or than blood. Its specific gravity is 1·030 or 1·033. The appearance of pus is well known; it is a creamy fluid, which, when normal or 'laudable' and fresh, has a very faint, not offensive odour, and no sign of putrefaction. Under certain circumstances, it has a strong ammoniacal or putrefactive odour, and is described as 'unhealthy,' or sanious. When allowed to stand, all pus separates into a liquid portion or 'serum;' and a sediment consisting chiefly of the corpuscles. The serum resembles blood-serum, containing paraglobulin or fibrino-plastic substance, potash-albuminate (or casein), ordinary serum-albumen, and myosin. Other constituents of pus are protagon, chondrin, gelatin, leucin, tyrosin, and xanthin.

Pus-corpuscles.—The corpuscles of fresh newly-formed pus, as seen, for instance, on an inflamed mucous surface, are not distinguishable from leucocytes of the blood, showing active amœboid movements, and continual change of form. Most corpuscles from large collections of pus, such as abscesses, are already dead, being nearly spherical in form, with the appearance of a cell-wall, and showing when acted upon by acetic acid three or more small nuclei.

Suppuration.—While the production of individual pus-corpuscles is to be explained in the same way as that of inflammatory cells in general, there are some reasons for thinking that the formation of pus requires, in addition, more special causes. Where a collection of pus, or an abscess, is formed, it is probable that the tissue-cells take an especially active part in the formation of new elements. Suppuration is preceded by hardening and swelling of the connective tissue, a change which Stricker refers entirely to enlargement of the connective-tissue bundles. He asserts that even in the cornea this hardening is seen in those parts where pus is afterwards formed. While, therefore, we cannot say that pus is formed solely from connective tissue, we admit that the proliferation of the tissues has a more important share in suppuration than in other forms of inflammation.

Another most important view as to the *cause* of suppuration is suggested, though not proved, by modern processes in surgery, which show that the entire exclusion of air containing solid particles, and any air but that which has been subjected to the action of antiseptics, prevents the occurrence of suppuration, even after severe injuries or operations. It is probable, therefore, that these septic particles or bacteria are largely concerned in the production or keeping up of the suppuration, as distinguished from milder forms of inflammation.

Vascular connective tissue.—When a part has been destroyed by inflammation, the lost tissue is replaced by the preliminary formation of a peculiar structure, consisting of a highly vascular connective-tissue framework, containing an excessive number of leucocytes. The vessels are of delicate structure, and easily lacerated. This tissue also contains nerves. It has been compared to the cellular structure which composes the embryo, or to *embryonic* tissue, but the great predominance of vessels constitutes an important difference. Such tissue always originates as an outgrowth of the vessels of the inflamed part; it grows into regular connective tissue, and is thus the most important means of replacing the tissue destroyed. When produced on a surface, and growing out in the form of tufts, it receives the name of *granulations*; and, as is well known, ulcers and cavities become filled up by it. There is no doubt that granulation-tissue may form fibrous tissue, and probably other forms of connective tissue; but it is still uncertain whether epithelial structures ever pass through this stage, and whether nervous or muscular tissue is ever thus regenerated.

Varieties.—The most striking differences between different kinds of inflammation are those depending upon the differences of tissues, and of the situations in which it occurs.

1. *Catarrhal.*—On mucous membranes, the exudation is mucous, does not coagulate, and contains only detached epithelial cells, with scattered leucocytes; the process readily becomes chronic; but the effect on the body as a whole is less marked than in other forms. This is *catarrhal* inflammation, a term which is with less propriety transferred to inflammations of the skin, the lung, and some glandular organs.

If catarrhal inflammation is very severe it becomes purulent, and the exudation consists chiefly of pus, little or no mucus being produced. This purulent catarrh is especially characteristic of specific inflammations of the mucous surfaces, such as virulent conjunctivitis or gonorrhœa.

2. *Croupous or fibrinous.*—Croupous inflammation is that form in which a coagulable exudation is formed upon a mucous surface. In diphtheritic inflammation there is, besides a membranous exudation, some necrosis of the mucous membrane. In these forms the tendency is to acute, not chronic, disease; and the general symptoms are strongly marked. The name croup has also been transferred to certain inflammations of the lung ('croupous pneumonia') and of the kidney, but, in the latter case especially, with doubtful propriety.

The *fibrinous* form may be regarded as the normal or usual form of inflammation of serous membranes and connective tissue.

On serous surfaces the lowest degree of inflammation is seen in a serous exudation, containing little or no plasma, hardly to be distinguished from simple dropsy; but there is no clear line between this and a coagulable exudation, or fibrinous inflammation. This too, if still more severe, may become purulent; and, as we see in the pericardium or pleura, a purulent may succeed to a fibrinous inflammation. Finally, vascular connective tissue, forming adhesions, is generally produced. In areolar connective tissue, and in the interstitial tissue of various organs, the same stages may be distinguished, known as *inflammatory œdema*, which occurs near a focus of acute inflammation; *inflammatory hardening*, such as precedes the formation of an abscess; and, finally, either abscess itself or purulent infiltration—the two forms of suppuration in connective tissue.

3. *Parenchymatous.*—It is not so easy to define the kinds of inflammation as affecting the special elements or parenchyma of organs. The lung appears to be an exception to the general rule that epithelial surfaces show the catarrhal form of inflammation, since lobar pneumonia is a type of the fibrinous form; but it should be remembered that the anatomical structure of the air-vesicles more resembles a serous than a mucous surface, having only a single layer of epithelium; and that a catarrhal form of inflammation is always the result of mechanical injury to the lung.

The name parenchymatous inflammation has been given to those changes occurring in the special tissues of organs, independent of their connective-tissue framework. The only factor common to all such appears to be a granular degeneration of the protoplasma of their cells, identical with what is elsewhere called albuminous degeneration, though it may end in fatty or other degeneration. In contradistinction to this, inflammation of the connective-tissue framework is termed *interstitial inflammation*.

4. *Phlegmonous.*—Phlegmonous inflammation is the same as *acute interstitial inflammation*, that is, the formation of abscess.

5. *Indurative.* — Indurative inflammation is that in which new connective-tissue is produced in the interior of organs. This is *chronic interstitial inflammation*.

6. *Degenerative.*—This variety of inflammation hardly needs explanation.

7. *Scrofulous.*— Scrofulous inflammation is that type which occurs in cachectic persons, whose tissues are easily injured and heal slowly. Such persons are subject to chronic inflammations which, further, involve destruction of tissue, and in which the inflammatory products readily undergo degeneration; unless these characters of destruction and degeneration are present, the name scrofulous has no precise meaning. *Strumous* is a word better forgotten, being synonymous with scrofulous, and liable to be misunderstood.

8. *Infective.*—Infective inflammations are those produced by the passage into the blood of infective matter derived from some previously existing inflammation. Pyæmia is a type; perhaps also tuberculosis.

9. *Chronic.* — Most inflammations have at first a typical course, reaching their acme and then declining. If the decline is not followed by resolution they become chronic. Others, again, show from the first the character they all along maintain. Chronic inflammations are usually distinguished by the persistence of that condition of the vessels which permits exudation and cell-emigration, with less hyperæmia and general fever than in the acute form. On mucous surfaces the chronic form differs little from the acute, except in these two respects. In serous membranes chronic inflammation produces fibrous adhesions, with little or no liquid exudation. In the interstitial tissue of solid organs a large amount of new connective-tissue is produced by chronic inflammation, which first compresses the special elements, causing them to waste, and then contracts in bulk, so that the organ becomes atrophied, and usually harder and more fibrous. This is the process called 'fibroid degeneration,' as in cirrhosis of the liver. 'Chronic parenchymatous inflammations' are simple degenerations, as seen in the kidney.

Terminations.—The most favourable termination of inflammation is what is called *resolution*, in which the vascular phenomena and tissue-changes decline together, and pass away without leaving any tangible material result. Even in the apparently most perfect cases of resolution, there is little doubt that products of exudation remain when the vascular changes have subsided, and are slowly removed by the lymphatics. Other so-called terminations are *necrosis*, or total death of the part; and partial destruction by suppuration or *ulceration*. But if any loss of substance occurs, the inflammatory process cannot be regarded as at an end till the loss is wholly or partially restored by newly-formed connective-tissue. Where there is no destruction of tissue, but only masses of liquid or solid exudation, the inflammation is not, strictly speaking, resolved till these are removed. Very frequently an acute passes into a chronic inflammation.

Consequences.—(1) *Local consequences.*— If an inflamed part does not simply return to its original state, *atrophy* is the most common consequence. *Hypertrophy* can hardly be said to occur in the part actually inflamed, though it may in adjoining parts, as we see in enlargement of bone from periostitis. False hypertrophy, from new formation of connective-tissue, is common, but as such tissue contracts, the final result is atrophy. The hardness of this tissue causes *induration* to be put down among the consequences of inflammation.

(2) *General consequences.*—The effect of inflammation on the whole body is to produce the condition of *fever*, which is discussed in another part of this work. It will suffice here to say that fever involves raising of the body-temperature, weakening and acceleration of the heart, and disturbance of the nervous system, as well as of all the nutritive processes. It was formerly supposed that local inflammation produced fever simply through the increased production of heat by more rapid tissue-change in the inflamed part; this process raising the temperature of the blood passing through the part, and thus of the whole body by means of the blood. But this simple explanation is not adequate. It has even been much disputed whether the heat of inflamed parts ever surpasses that of the blood. The temperature of inflamed external parts is higher than the normal in that situation, or than that of a corresponding part, not inflamed, on the other side of the body. But this is also the case in hyperæmia, in which condition the external temperature never surpasses that of internal organs. Experiments on inflammation have led to very conflicting results: those of Simon and Weber being directly opposite to those of Jacobson and others. But even if we assume an actual production of heat in inflamed parts, this will not be enough, as is shown by calculation, to account for the rise of temperature in the whole body. It has also been supposed that some fever-producing or *pyrogenic* substance passes into the blood from every inflamed part, and causes increased tissue-change, with consequent increased production of heat through the whole body. But till the pyrogenic substance is known, this view does not go beyond hypothesis. Finally, it is held that the nervous system has a large, or even the chief share in the production of fever; the inflamed part acting through the nerves on the centre controlling the temperature of the body, which physiologists place in the medulla oblongata. But none of these theories is definitely established, and the manner, therefore, in which local inflammation produces fever is not yet perfectly understood. The degree in which local inflammations cause fever varies, and does not appear to depend wholly on the mass or the intensity of the inflammation, though both these conditions are partly concerned. Acute inflammations produce more fever than chronic; those of connective-tissue more than those of mucous surfaces; and, most of all, those which end in suppuration. In infective inflammations the fever is generally high, but not to be attributed to the local inflammation, being a concurrent effect of the same cause—the infective poison. Besides general fever, the special condition called *pyæmia*, in which other local inflammations result, may be a consequence of primary inflammation; but here, probably, some other factor is at work. *See* Fever; and Pyæmia.

Ætiology.—Most inflammations are caused by some injury—either mechanical, as by actual violence; or physical, as changes of temperature; or chemical, by powerfully acting substances, as acids, alkalies, and many more. A most important secondary factor is the condition of the body, whether under- or over-nourished, or in some other way wrong; and this may probably be still more closely defined as the condition of the blood-vessels. Many parts of the body, as the skin and the stomach, are constantly exposed to injury, but do not become inflamed unless from some internal cause; and, therefore, a change of nutrition may be the apparent or immediate cause. It is also clear that certain inflammations, as herpes zoster, are determined by disturbance of the nerves; and it is very probable that similar nervous disturbances cause other local inflammations. Besides these there are certain specific causes, namely, infective or specific poisons, which, when introduced into the blood, produce local inflammations. Many local inflammations, external and internal, appear to arise spontaneously, neither irritation nor fault of nutrition being easily traced. Such are, for example, carbuncle and pneumonia. But in these, as in others, it is already probable that some infective cause is at work. It is also probable, and in some cases proved, that other inflammations which were at one time thought spontaneous, are really secondary, depending upon some previous local inflammation, even without what is called actual pyæmia. Thus the number of such apparently spontaneous inflammations is gradually lessening.

Treatment.—We shall divide this subject into the treatment of *directly accessible* (chiefly external) inflammations; and that of *indirectly accessible* (internal). Treatment will also differ according as the inflammation is acute or chronic; according to the stage, if acute; and also according to the constitution of the patient.

a. Directly accessible.—Directly accessible inflammation in an early stage may be treated by local blood-letting, and by astringents. The benefit of local blood-letting in an early stage is undoubted, and is probably due to its relieving the condition of stagnation, and permitting freer circulation of blood in the part. The type of astringents is *cold.* When the vascular disturbance, that is, hyperæmia, is great, and the general fever high, cold, produced either by ice or evaporation, is generally the best treatment. In the case of mechanical injuries, for instance, it may be regarded as an ascertained fact that if any injured part be kept cold during the period of reaction, the inflammation is less severe. When the condition of stasis, with exudation, is set up, the effect of cold is less marked; and if a temporary benefit is produced, the condition after the application of cold is stopped may be as bad as ever, or perhaps worse. The defect of cold as an antiphlogistic seems to be that, though it reduces hyperæmia, and if sufficiently intense actually checks inflammation, it does not remove the condition of the vascular wall on which stasis and the associated changes depend. Cold is also a powerful nervous sedative, and reduces the nervous irritability of inflamed parts. It is remarkable that an effect like that of cold is produced by solutions of certain *metallic salts*, especially those of lead, zinc, silver, and bismuth. These salts furnish the most certain and direct means of treating an inflammation in parts actually accessible to their action. Hence they are used in superficial inflammations of the mucous membranes, such as the digestive mucous membrane and the conjunctiva, and of the skin. Their use

is limited by the difficulty of bringing them in actual contact with deeper inflamed parts. But Mr. Hutchinson has shown that even in severe injuries the antiphlogistic effect of lead is quite equal to that of cold, if it can be made to pass deeply enough into the injured parts. These mineral (and vegetable astringents also) act more potently on the exudative processes of inflammation, than on the vascular disturbance. Hence their activity is most valuable when that of cold ends; and they have a striking effect on chronic inflammations which are unaffected by cold. Even *pressure* may be useful as an astringent, as we see in strapping a testicle or an inflamed joint. In applying all astringents, it is of the first importance to be sure that they actually arrive at the inflamed part. In applying ice to the chest for pneumonia or pericarditis, for instance, this result is very doubtful.

In the treatment of even acute inflammations, the precisely opposite application, that of *heat*, is sometimes valuable. Hot and cold have respectively always had their partisans, and have been, we think, needlessly opposed. If it were possible to apply a temperature high enough to kill leucocytes, it is probable that most inflammations might be suddenly brought to an end. Almost the only instance of this is the cure of a whitlow on the finger by plunging it into hot water; a treatment which would be more satisfactory if the necessary temperature were precisely fixed. Short of this, heat doubtless increases the activity of most inflammatory processes. But heat combined with *moisture* is the type of an *emollient*, by which the substance of inflamed tissues is relaxed, the blood-vessels dilated, the sense of tension and nervous irritation removed, and though exudation-processes are probably encouraged, the *mechanical* condition of stasis is relieved, and resolution is thus hastened. When pus is forming, there is little doubt that heat and moisture (in the form of poultices and fomentations), hasten the process, and increase the amount of pus formed; but the amount of pus is often of no great consequence, and it is more important to hasten the process. Thus it may be the right treatment for suppuration. When pus is once formed, the same treatment is useful in guiding it in the direction in which it is least hurtful. Finally, it may be beneficial to apply heat and moisture superficially, to relieve deep-seated organs, by stimulating the vascular and lymphatic circulation through the skin. Thus, in applying poultices for pneumonia we do not make the lung or even the pleura hotter, but relieve the overloaded blood-vessels and lymphatics.

Further, in treating all superficial inflammations we must guard against anything which increases the injury, such as movement, further irritation by the air or anything contained in the air. Thus, in some skin-diseases, as herpes zoster, secondary inflammation is prevented by an artificial covering of collodion. Antiseptic surgery shows that not the air, but something in the air, is to be feared, and if this is excluded much inflammation is prevented. The benefits of mechanical rest in treating injuries of the limbs need not be more than mentioned; nor that of physiological rest, wherever it can be obtained, in threatened or existing inflammation of any active organ whatever—for example, the brain, the stomach, or the kidney.

In many acute inflammations, however, where the course of the inflammation is known, and we know we cannot absolutely stop the process, our best method may be merely to apply palliatives, that is, to adopt an *expectant method*.

Diet is also of great importance. There is little doubt that the intensity of all inflammations is lessened by greatly diminishing the food taken. In some acute inflammations, especially fevers, we may pursue a different system, with the view of saving the patient's strength; but it is possible that in the reaction against the starving process, feeding may be sometimes carried too far.

In the treatment of *chronic inflammation* in accessible parts, the first aim will be to check the exudation and cell-migration, that is, to bring the vascular wall into a healthy state. Here we find that metallic and vegetable astringents are most useful. But it may, with the same object, be well to draw more blood into the part, in order that the vascular wall may be better nourished. This is effected by *stimulants*, which are of well-known efficacy in chronic inflammation. These agents are for the most part the same as astringents, but in a more concentrated form—nitrate of silver, sulphate of copper, &c.; but also some aromatic substances, as tar, which is used in chronic inflammations of the skin, copaiba for the urethra, &c. Again, it may happen that it is best to sweep the old tissue away, and allow new vessels to be formed, which will probably have healthier walls. This is effected by destructive *caustics*, as nitrate of silver, potassa fusa, chloride of zinc, or even the actual cautery.

In chronic inflammations, internal treatment is often of great service, as we shall presently show.

b. Indirectly accessible.—The treatment of indirectly accessible inflammations, or, what amounts to the same thing, the treatment by internal (general) methods even of directly accessible inflammations, is much less satisfactory than the local.

The first indication is to give the part actual rest, mechanical or physiological; the next, to consider if there is any way of reducing the intensity, either of the local reaction, or of the fever. Of such means the chief are general blood-letting; the general application of cold; and certain drugs called vascular depressants, such as mercurials, antimonials, purgatives, digitalis, aconite, quinine, and a number more.

Of *general blood-letting* we cannot say much here. There can be little doubt that it often lowers the energy of inflammatory processes in an early stage. If it has gone out of use, it is probably because the course of many diseases is now better known, and we do not expect to cut them short; because the list of infective diseases is enlarged; and because the benefits are supposed to be outweighed by the supposed drawbacks in diminishing the strength of the patient. Of *cold baths* we need only here say that they are far more potent in checking the condition of fever, than in stopping local inflammation. Of *drugs*, digitalis is supposed to act by depressing the heart's action; but in theory this is doubtful, and in practice we see little effect on organic inflam-

mations. Aconite also has little local effect, but does modify the febrile state. Quinine is thought, on theoretical and experimental grounds, to check the emigration of leucocytes, and to kill organised bodies or germs resembling bacteria. The first belief is experimentally true if the drug is in a certain degree of concentration; but we have no safe means of introducing it, in this degree of concentration, into the blood. Alcohol even has been recommended as an antiphlogistic, on the ground that it lowers the temperature in health. But even this is not constant, and there is no good reason for thinking that it has this effect in fevers, still less that it checks the inflammatory process. If alcohol be given, it must be on other grounds. Salicylic acid, carbolic acid, and thymol are lauded as destroying fever-germs; but, as with quinine, we cannot get them into the blood in sufficient concentration, and if we could, it is probable that other more serious disturbances would be produced.

The conclusion must be that there is no one drug which is capable of controlling local processes of inflammation, though the resulting condition of fever may be modified.

The use of mercurials and antimonials seems to have been affected by the same considerations as blood-letting. The action formerly attributed to them is now doubted, and it is further thought they do harm in other ways. But no adequate explanation has been given of the difference in this respect between the practice of this and the last generation. Purgatives remain as a harmless, unquestionable, but not very potent antiphlogistic method.

In the general treatment of *chronic* inflammations we have more satisfactory principles. It is in cachectic persons, or persons with an inherited proclivity (perhaps not yet manifest) to cachectic diseases, that inflammations most tend to become chronic. Hence, the first rule is to improve the nutrition. Many patients with chronic inflammations get well at once when placed in good quarters, and on good food. Next in importance come nutrient tonics, of which cod-liver oil is the chief. There are few chronic inflammations in which it does not do good. Iron is very often valuable; and, if it fail or is contra-indicated, arsenic may be employed. In chronic inflammations of fibrous tissues, iodide of potassium has a real value, not easily explained. In treating other inflammations, either acute or chronic, there are many specific remedies, but these are remedies for the disease, not for its inflammatory features only. For this reason, we do not here speak of mercury, colchicum, salicylate of soda, and other agents.

Finally a most important means of treating indirectly accessible inflammations must be mentioned, namely that by *counter-irritants*, or setting up a rival inflammation. In order to relieve an inflammation, for instance, of the knee-joint, we produce a superficial inflammation of the skin. This is most used in chronic, but applies to some acute inflammations also. Various explanations have been given of the undoubted efficacy of this treatment. Some believe the action is transmitted through the nerves; others that blood is drawn away; others that the lymphatics are stimulated. The writer's belief is that in the most marked cases of benefit from counter-irritation, there is a continuity of tissue between the inflamed organ and the part where the counter-irritant is applied, and that the action may sometimes consist in drawing away blood; but generally this is not possible, and the benefit results from setting up currents of plasma through the lymphatics and the connective-tissue spaces. It should be noted that in some inflammations, where œdema is a marked feature, simple puncture has an unquestionable efficacy which may perhaps be explained in the same way. The substances used for counter-irritation are either vesicants, such as cantharides or ammonia; or rubefacients, as mustard and iodine. Dry heat at different temperatures may produce the effect of either of these classes. When redness is produced on the skin, it does not follow that hyperæmia alone results. In fact the desquamation often shows that a low form of inflammation has been established. We have here endeavoured to give the principles only of the treatment of inflammation. For the treatment of inflammations of special parts, the articles on these subjects, as well as the articles on Blood, Abstraction of; Counter-irritation; and Heat, Therapeutics of, must be consulted.

J. F. Payne.

INFLATION (*inflo*, I blow into).—A term applied, therapeutically, to the method of blowing air or gas into any hollow space. It is employed particularly in connection with the lungs in the process of artificial respiration (*see* Artificial Respiration). It is also used for the purpose of dilating the bowel in cases of obstruction (*see* Intestinal Obstruction). The term inflation was formerly used, pathologically, as a synonym for emphysema of the lungs, but is now more strictly limited to the condition in which the alveoli are temporarily distended with air, from any obstruction in the air-passages. *See* Lungs, Emphysema of.

INFLUENZA.—Synon.: Epidemic Catarrh; Fr. *Grippe*; Ger. *Influenza*; *Epidemischer Schnupfenfieber*.

The term Influenza is said to have been first introduced in 1741, when the disease was prevailing in the North of Italy, and it has been generally adopted in this country; though the more scientific term—Epidemic Catarrhal Fever—is often used in systematic works.

Definition.—This disease is not to be regarded as simply an unusually prevalent common catarrh, but must be considered as a specific affection, which appears occasionally over wide districts, and at or about the same time; is characterised by marked febrile symptoms; is often attended by serious complications; and causes great and prolonged prostration of strength.

Occurrence.—Various epidemics of influenza are on record from the middle ages down to more recent times, and those which have occurred in the last and present centuries have been fully described. The disease is reported to have prevailed in 1729, 1732–33, 1737, 1742, 1758, 1762, 1767, 1775, and 1782, and in 1803, 1833, 1837, and 1847. The following account is chiefly founded upon the disease as it prevailed

in 1847, but the description given of its peculiarities corresponds with the accounts of previous epidemics.

The disease may be described as assuming three distinct forms:—

1st. That in which it is *simple*, or unattended with any serious complication.

2nd. When it is *complicated* by serious affection of the aërial mucous membrane, and especially with bronchitis and pneumonia; and

3rd. When the *disorder of the digestive organs*, which generally exists to some degree in the disease, becomes a more prominent character; while there are marked rheumatic symptoms, and a tendency to assume a remittent form.

The description would also be imperfect without reference being made to the *modifying influence* which the epidemic exerts *over other diseases* prevailing at the same time, and especially over the specific fevers.

1. Simple Catarrhal Fever.—Symptoms.—In this form of the disease the attack is most commonly sudden. The patient experiences a sense of cold down the back and between the shoulders, lapsing into general chilliness or complete rigors, and succeeded by flushes of heat and dryness of the skin, pain in the head, chest, and extremities, and prostration of strength. Generally these symptoms follow some exposure to cold and damp, but occasionally they appear without being traceable to any immediately exciting cause, and more rarely the attack comes on gradually, with a general feeling of indisposition of two or three days' duration.

At first there is dryness of the nostrils and soreness of the throat, with a sense of tightness or constriction of the chest, and a dry, hard cough. As the disease advances, copious defluxion from the nostrils takes place; the throat is often seriously affected; and the cough is more frequent. The expectoration is at first scanty, and consists of a pale glairy fluid; but at a later period there is more copious discharge of opaque mucus. At the same time some degree of difficulty of breathing and soreness at the chest are experienced. The respiration is in most instances accelerated; and, on auscultation, the inspiratory sounds are dry and harsh, especially in the posterior and inferior parts of the chest, and sibilant and sonorous rhonchi may be audible on forced inspiration. In some cases no marked sounds are heard, but the vesicular murmur is very indistinct. A sense of chilliness, alternating with flushes of heat, is a general symptom throughout the progress of the attack; and there is distressing headache, particularly in the forehead, across one or both eyebrows, as well as pain in the balls of the eyes. These symptoms often undergo considerable remission during the day, and become much increased in severity towards night. There is also commonly much mental depression, listlessness, inability for intellectual exertion, and nocturnal restlessness. The tongue is usually moist, and covered with a white creamy fur; but occasionally it is morbidly red at the tip and edges, and thickly coated with a whity-brown fur towards the centre and root; more rarely, and especially in the morning, it is dry. In the greater number of cases, entire loss of appetite, with some nausea, and a confined state of the bowels, are present from the commencement; but occasionally diarrhœa is observed at an early period, and not unfrequently it comes on during the progress of the disease. Sense of weight, tenderness, and pain in the right hypochondrium are frequently experienced; and there is often some icteroid tinging of the conjunctivæ, or of the general complexion. The urine is scanty and high-coloured at first, but subsequently becomes more free, and deposits some sediment.

Prostration of strength is throughout one of the most marked and distressing features of the complaint, and there is a general feeling of soreness, with dull aching pains in the chest, back, and limbs. The pulse is but little varied in frequency, generally ranging from eighty to ninety, and rarely exceeding a hundred beats in the minute. Though occasionally full, it is uniformly very compressible, and, after the first day or two, feeble. The skin is seldom hot or very dry, or, if so, it is only at the commencement of the attack, and it soon becomes cool and moist; the complaint usually subsides with free perspiration.

The ordinary duration of the indisposition in this form of the epidemic may be stated at from three to five days in the milder cases, and from seven to ten in those of a more severe description. The disease, however, on its subsidence usually leaves the patient for some time much prostrated, and suffering from loss of appetite, inaptitude for bodily or mental exertion, and a troublesome cough. There is a great tendency to relapse.

Not unfrequently towards the termination of the attack the transient pains, which are troublesome during its course, increase in severity, and rheumatic affections of an obstinate and painful character supervene. These often assume a remittent or intermittent form, returning regularly at the same hour for several days in succession, and not unfrequently affecting one side of the head, or one eyebrow or eyeball, and occasionally the intercostal muscles of one side of the chest.

2. Epidemic Catarrhal Fever with predominant Pulmonary Affection.—Symptoms. It has already been noticed that some amount of soreness of the throat, and uneasiness or pain in the chest, with cough and expectoration and slight bronchitic signs, are observed in the cases of the epidemic which might be considered as assuming the simple form. Not unfrequently, however, the symptoms of affection of the aërial mucous membrane are more marked, there being decided quinsy, laryngeal symptoms, croup, bronchitis, or pneumonia. Of these, however, the most frequent and important are the bronchitic and pneumonic complications.

The bronchitis has especially the tendency to assume the acute capillary form. In cases of *acute capillary bronchitis* occurring as a complication of influenza, there is usually in the *early* stage increased frequency and some difficulty of breathing, constriction of the chest, and soreness or stiffness of the throat. The cough, though slight, is troublesome from its frequency. The expectoration, if there be any, is scanty and of a glairy character. The tongue is usually red at the tip and edges, and covered at the dorsum

with a creamy mucus or with a whity-brown fur; occasionally it is morbidly red throughout. The pulse is accelerated, beating generally 110 to 112 or 116 in the minute, and occasionally more. The skin is not usually hot, except it be at the commencement of the attack, and if so it usually becomes cooler in two or three days. With these symptoms there are the marked prostration of strength, the severe frontal headache, the general soreness of the body, and the pain in the back and limbs, which characterise the ordinary cases of influenza.

When the chest is examined in this stage of the disease, the only morbid signs detected are a roughness of the inspiratory sound, particularly when a forced inspiration is drawn; some slight crepitation, audible more especially towards the lower part of each dorsal region; feebleness of the vesicular murmur; and perhaps slight sibilant rhonchus in front. The respiration is, however, quicker and shorter than natural, averaging 28, 32, or 40 in the minute; the dyspnœa is greater than is explained by the obvious physical signs; and most generally there is some lividity of the face.

In the *second* stage all these symptoms are much aggravated. The respiratory acts are performed quickly and imperfectly, the respirations in the minute varying from 30 to 40 or 50. The cheeks are much flushed, and the lips of a somewhat purple colour. Generally there is not acute pain in the chest, but rather a sense of constriction and soreness; the cough, though frequent and occurring in paroxysms, is not usually severe. The expectoration still continues scanty, and consists of small yellowish-white pellets, forming tenacious masses of a peculiar nodulated or botryoidal form, very much resembling, when floating in water, fragments of some of the large oolitic limestones. The tongue is mostly covered with a thick whity-brown fur, and somewhat dry and often red at the tip and edges; or morbidly red and glazed. The pulse is much accelerated, beating 120, 130, or 140 times in the minute, but it is generally small and very compressible. In some instances, after being low and feeble at the outset of the disease, it acquires a more sthenic character in the second stage. The skin is rarely dry, or much above the natural temperature; and the hands and feet are generally cool. The skin of the extremities is also much congested, so that when blanched by pressure, the colour does not readily return. The prostration of strength also becomes greater; and there is much headache, and often transient delirium, especially during the night. On percussion, the chest does not present any marked alteration of resonance, unless there exists some other disease of the lung; and on auscultation, crepitation of a more or less fine character is audible with the inspiration, first in the inferior part of one or both dorsal regions, then spreading rapidly higher up in the back and toward the bases of the lungs in front, whilst sibilant rhonchus is heard in other parts of the chest.

The *third* stage of the disease is marked by the dyspnœa becoming so severe that the patients are compelled to sit constantly upright in bed, or to lean forwards, resting on their arms and elbows; whilst at intervals the respiration becomes very laborious. The lividity of the cheeks, lips, and hands is increased; the eyes become prominent; and the expression of countenance is extremely anxious. The cough is frequent, and of a short abortive character, giving the impression of viscid secretion in the lung, which the patient has not power to expectorate; whilst it is aggravated by paroxysms, which cause pain in the head, and increased lividity. The sputum now becomes large in quantity; it is of a greenish-yellow colour, very viscid, contains little air, and is occasionally streaked with blood. The respirations are very frequent, 50 to 60, or even more; and expiration is very laboured and prolonged. The pulse is very feeble, and either extremely quick—140, 150, or 160 in the minute—or intermittent, so as to number only 100 or 120 beats. The tongue is covered with a thick yellowish-white or brown fur, and is generally dry; sordes also form upon the teeth. The general surface of the body becomes cool and bathed in perspiration; and the hands and feet decidedly cold. The delirium is more constant; with the decaying strength the cough declines; the expectoration ceases or becomes slight; and the patient sinks.

With the progress of the disease the physical signs change. The chest in front yields a uniformly clear sound on percussion, while behind there is a general impairment of the resonance. The crepitation gradually extends over larger portions of the lungs, being of a finer character in the parts more recently involved; giving place to subcrepitant and mucous rhonchi in the situation in which it was first heard; and finally becoming of a gurgling character in the neighbourhood of the larger bronchial tubes. The subcrepitant rhonchus also towards the end of the attack is heard with the expiration as well as with the inspiration; and if there is some local condensation, bronchial respiration may be developed.

In the cases which terminate favourably, the amendment is marked by the respiration becoming less hurried and laborious; by the expression of countenance being less anxious, and the face less livid; and by the prostration of strength decreasing. The pulse becomes less frequent, the cough less severe, and the sputum less viscid—more of a muco-purulent character with a tendency to form a homogeneous mass, containing large air-bells. At a later period it becomes thinner, and declines in amount. The mucous and subcrepitant rhonchi are replaced by finer sounds, and the space over which the morbid signs are heard diminishes—these disappearing first in the upper part of the chest, then at the front and sides, and lastly in the dorsal regions. The clearness of the sound on percussion on the front of the chest also passes away, and is often succeeded by a somewhat dull sound; and the respiratory sounds become indistinct. The convalescence is, however, generally protracted; the patient is liable to returns of dyspnœa at intervals; and the cough continues troublesome. After the subsidence of the pulmonary symptoms, the rheumatic pains, if previously present, may become aggravated, or may then first appear and become troublesome, affecting the head, face, or

intercostal muscles, and being aggravated towards night.

Anatomical Characters.—On examination after death, one of the peculiar features of this form of disease is the extremely inflated condition of the lungs, which in lieu of collapsing when the chest is laid open, in some cases protrude from the cavity. This condition is not limited to certain parts in which there are larger or smaller bullæ, but consists in a general inflation of large portions of the lung. The mucous membrane of the bronchi is reddened, and the injection increases towards the smaller tubes, where the membrane may be intensely red and have a villous appearance. The lung-tissue in the cases proving fatal at an early period has a peculiar dry appearance, but in the later stages it is œdematous. There is also more or less lobular condensation, the condensed parts being depressed below the adjacent inflated tissue, and having a deep purple colour. At a later period the condensed tissue may soften from the presence of pus, and small cavities may be formed in this manner. The bronchial glands are enlarged and softened. The cavities of the heart, especially on the right side, are distended with firm and more or less decolorised coagula.

Prognosis and Duration.—The cases of influenza complicated by acute capillary bronchitis are always very serious in their character; and when the disease occurs in persons who have before been out of health, and especially if there be any previous disease of the lungs or heart, or if the subjects be very young or elderly, they prove fatal in a large proportion of cases. The duration of the disease in the cases which prove fatal is from about ten to fourteen days; and when recovery occurs, the patient is ill from a fortnight to three weeks, or longer.

Pneumonia.—In the cases of pneumonia which were seen during the prevalence of the last epidemic of influenza, the disease was very generally combined with bronchitis, either affecting the larger or smaller tubes, yet the cases were less serious than those in which the disease assumed the form of acute capillary bronchitis alone. This is the more remarkable as they were more frequently combined with serious disorder of the abdominal organs, and with rheumatic symptoms, and were attended with great prostration of strength. Of the symptoms in these cases, cough is one of the most troublesome; the expectoration is peculiar, partaking both of the glassy, transparent, or opaque character of the sputum of bronchitis, and of the brownish viscid expectoration of pneumonia, with the usual small air-bells. In some cases, however, when there is great prostration, there may be no expectoration. Pain in the chest is generally experienced at the invasion of the disease, of a more or less severe character, but afterwards it is not present to any marked extent, or is only experienced when the patient has a severe paroxysm of coughing. The dyspnœa also is not severe, and there is not much lividity of the face, unless in cases in which there is also considerable bronchitis. The breathing is not usually very rapid, the respirations not exceeding 28 or 32 in the minute. The pulse also is comparatively quiet, beating 80, 90, or 100, and it is usually soft and compressible, or decidedly small and weak. The skin, as in the other forms of influenza, is not generally hot or dry; or, if so at the commencement of the attack, it soon becomes cool and moist. The tongue has usually the whity-brown covering which has before been described, and is not dry; but sometimes it does become dry and brown. There is often very marked disorder of the digestive organs—sickness and vomiting and diarrhœa; and usually some slight jaundiced tinge of the skin is observed. There is also not unfrequently some delirium and stupor of mind; and the prostration of strength is often extreme. On examining the chest, in addition to the signs of bronchitis, which are always present to a greater or less degree, there are the usual indications of pneumonia. At first fine crepitation is perceived in the seat of the disease; to this more or less marked dulness on percussion, bronchial respiration, and increased resonance of the voice and cough succeed; and these signs, though generally found in one or both dorsal regions, may be more widely diffused. Notwithstanding, however, the threatening character of the symptoms, it was observed in the epidemic of 1847 that the disease was not very fatal, and the signs of consolidation disappeared more readily than in most ordinary cases of pneumonia. The resolution was shown by the return of crepitation, though of a coarser character, in the seat of consolidation; and by the gradual diminution of the bronchial respiration, and of the dulness on percussion. After a time the natural vesicular breathing again became audible. The duration of the disease was very similar to that in the cases of acute capillary bronchitis. In this, as in the other forms of influenza, the convalescence was often very protracted; there was the same tendency to recurrence of the symptoms on any slight exciting cause; and the rheumatic pains often long continued to distress the patient.

3. Catarrhal Fever, complicated with gastro-intestinal affections and rheumatism, and of a remittent character.

It has already been stated that in the last epidemic of influenza, there were very generally present more or less marked symptoms of gastro-intestinal and hepatic disorder; and that rheumatic pains, having a more or less decidedly remittent character, were very usually observed. It has further been said that in the cases in which the pulmonary complication assumed the pneumonic form, these symptoms were generally more marked than in the cases of acute capillary bronchitis.

In some cases, however, the latter symptoms were, throughout, the predominant feature; and as similar observations have been made as to former epidemics, cases of this kind may fairly be regarded as constituting a special form of the disease.

In this form of the epidemic, nausea and sickness generally occurred at an early period of the attack, and often became very urgent symptoms. The matters vomited often had a bilious tinge; and there was generally a marked bilious tinge of the conjunctivæ and general surface of the body, amounting in some cases to decided jaun-

dice. There was often diarrhœa; and sometimes blood was passed in the stools. The pains in the head, back, loins, and extremities, which are present with more or less severity in all forms of influenza, were from the first of a severe character, or increased with the progress of the disease till they constituted a predominant feature. The pain was usually most distressing in the head, especially in the forehead, and in some cases was limited to one temple, one eyebrow, or one eyeball. This was generally of an intermittent or remittent character, coming on at night after more or less distinct remission during the day; and was attended with singing in the ears, distressing restlessness, agitation, and inability to sleep, whilst delirium generally increased during the exacerbation. In some cases it only amounted to a little excitement and incoherence, but in others it was so urgent as to require the employment of restraint to retain the patient in bed, and sometimes it continued without intermission for some hours. It was, however, remarkable how completely it subsided, as a rule, in the morning. With these symptoms there was usually much tremor of the extremities; and the eye was pale and glassy, though the pupil was frequently contracted.

Early in the attack the pulse was quick and feeble, and of a peculiarly vibratory character, though sometimes it was but little accelerated. At a later period it often became very rapid and feeble, or fell below the natural standard of frequency, being very soft and compressible, and occasionally intermittent. The tongue was at first moist, covered with the usual whity-brown fur, and red at the tip; subsequently it had a tendency to become dry. The breath had a peculiar, offensive, acid odour. Epistaxis occasionally occurred, and sometimes to an alarming amount. The skin was generally moist; and the perspiration had the usual sour rheumatic smell. The urine was at first scanty, but afterwards increased in quantity, and deposited much sediment of urates. Occasionally it was slightly albuminous.

With these symptoms there were evidences of some pulmonary disorder—bronchitis or pneumonia; and very frequently murmurs were heard at the heart, which were not, however, generally persistent.

After the exacerbations the sweating was often very profuse, so that in the morning the patient was found completely bathed in it, and the bedclothes were quite wet. The prostration of strength also was often extreme, so that the hands and feet became livid and cold, and the patient resembled a person in the algide stage of cholera.

Notwithstanding their severity, the cases of this third form of influenza generally did well, though the patients long suffered from the rheumatic symptoms, and only very slowly recovered their strength. As seen from the Registrar-General's reports, there was a great increase in the deaths from 'rheumatism' during the prevalence of the epidemic, which probably referred to cases of this kind.

4. Modifying Influence of the Presence of Influenza on other Diseases.—In all visitations of influenza of which we have detailed accounts, the epidemic has been attended by an unusual prevalence of other forms of disease, and especially of the specific fevers—and the features of such diseases have been much modified by the epidemic influenza. To this rule the influenza of 1847 affords no exception. As shown by the reports of the deaths in London and the country generally, there was a great increase in the total mortality; this especially showed itself in the zymotic class of diseases, but obtained also as to diseases of the heart, brain, and digestive organs. An unusual number of deaths were recorded from 'typhus,' under which head were then included the fevers which we now discriminate into typhus, typhoid, and relapsing fever. Of all these forms of disease, cases occurred during the time, though the chief prevalence was apparently of typhoid and relapsing fever. The features of these diseases were generally so much modified by the epidemic influence, and they were so constantly attended by pulmonary complications, that it was often difficult to decide whether any given case was to be regarded as a case of specific fever or of influenza. Various forms of local disease were also prevalent at the time, both as distinct affections, and as complications of specific fever, such as diphtheria, parotitis, otitis, stomatitis, and quinsy, with erysipelas, abscesses, &c.; and these were often attended by great prostration of strength, and added greatly to the danger of the various other forms of disease with which they were combined.

Pathology.—Every phenomenon of influenza points conclusively to the influence of some powerful depressing agent, operating on the nervous system, or entering the blood. The sudden seizure of a large proportion of cases; the extreme prostration of strength from the commencement, and to a degree disproportioned to the amount of local disturbance; the symptoms of disorder of all organs, and especially of the cerebro-spinal system; and the debility which so often succeeds even simple cases of the disease, can on no other supposition be explained. It seems probable also that the affection of the respiratory mucous membrane may be due to the morbific influence, whatever it may be, operating more specifically upon it; but it is extremely difficult to offer even a probable suggestion as to the nature of that influence. The almost simultaneous outbreak of the epidemic in places widely apart; the seizure of a large proportion of the population of a town or district within the course of a few hours; and the sudden illness of individuals or bodies of men visiting a locality where influenza is, or has very recently been, prevailing, and previous to direct intercourse with any persons actually suffering—are all circumstances opposed to the notion of the disease being dependent on infection in the ordinarily understood sense; and might seem to point to the operation of atmospheric influence as the cause. The conditions, however, under which the disease has presented itself in different epidemics, render such an explanation impossible. It has travelled over districts without reference to season or climate, and has prevailed in the same locality in all seasons and in almost every variety of weather. It is true that it has often broken out

after great meteorological changes, as in the last two epidemics after sudden and remarkable falls from a comparatively high to a very low temperature; but, on the other hand, epidemics have arisen under other circumstances, and such alternations of temperature frequently occur without the occurrence of an epidemic of influenza. The disease has also broken out at the same time at different places in which the same atmospheric conditions did not exist, so that the operation of the sudden change can scarcely be regarded as acting even as an exciting cause. There can, however, be no doubt that the more common predisponants to disease, such as defective drainage, overcrowding, impure air, deficient clothing, and insufficient or unsuitable food, powerfully conduce to the prevalence and fatality of the epidemic.

Treatment.—Of the treatment of the simpler forms of influenza it is not necessary to say much. The patient should be confined to bed; have a footbath; take some form of diaphoretic medicine; and be allowed a mild, unstimulating diet. If the cough becomes troublesome, or if there be pains in the chest, sinapisms may be applied, and some anodyne may be added to the medicine; and for the relief of the subsequent debility, stimulants, tonics, and a nutritious diet may be enjoined. In the cases complicated with pulmonary affections, the same measures may be used, in combination with expectorants and anodynes; and more decided counter-irritation may be applied to the chest. When there is very copious secretion, and the patient cannot expectorate freely, the greatest benefit is often derived from the use of emetics, and they may be employed with advantage in cases in which the patient's strength is too much depressed to allow of nauseating doses of medicine being given. To the use of emetics, the stimulating expectorants — squills, ammonia, &c.—should succeed. For the relief of the cases in which there is nausea and sickness or vomiting, effervescents with morphia, or hydrocyanic acid, may be given. When there is more or less jaundice, small doses of calomel or grey powder, in combination with Dover's powder, are very beneficial; and when there is diarrhœa the Dover's powder or decided astringents—such as acetate of lead, or tannic acid—may be employed. When the rheumatic symptoms are severe, the greatest relief is obtained by the administration of small doses of colchicum with carbonate of potash and opiates; and when the prostration of strength is great, ammonia, in combination with bark, should be given. In the cases in which there is a decided tendency to remissions and exacerbations, bark also may be prescribed, or, in the more severe cases, quinine; and quinine and other tonics should be freely given during convalescence.

In all cases of influenza all depressing treatment should be avoided. The cases do not require it, and the patients are too much prostrated to admit of its employment. In all the different forms of influenza it is necessary to administer support very freely, and sooner or later to exhibit stimulants. In the cases in which there is pulmonary or other local complication, the strength becomes more rapidly and more seriously depressed, and stimulants and support are still more urgently needed; and indeed it is necessary to have recourse to them at an earlier period, to exhibit them more freely, and to persevere in their use for a longer period in such affections, when occurring during an attack of influenza than when arising as idiopathic diseases. In the management also of the other forms of febrile affections which are seen during an epidemic of influenza, a more restorative and stimulating treatment is required than under ordinary circumstances, for all such diseases partake of the peculiarly asthenic type of the epidemic.

Thomas B. Peacock.

INHALATION, Ætiology of.—*See* Disease, Causes of.

INHALATIONS, Therapeutic Uses of (*inhalo*, I breathe in).—Inhalation is a method of applying remedial agents to the respiratory tract, whereby these substances in a gaseous or atomized form are brought into contact with the mucous membrane of the nose, mouth, pharynx, larynx, and bronchi, and may even penetrate to the epithelium of the air-cells. Inhalation dates from the days of Hippocrates and Galen, and has been more or less in vogue in all ages; but only lately has it been proved that the inhaled material passed through the finest ramifications of the bronchi into the pulmonary alveoli, and in some instances became absorbed by the capillaries, thus entering the general circulation. The examination of the lungs of colliers, grinders, and others engaged in dusty occupations has shown that the inhaled dust can be detected in the lung-tissue, where it induces chronic pneumonia. The experiments at the Academie de Médecine proved that medical sprays are equally penetrating.

Methods.—The modes of inhalation vary with the drug used, depending mainly on the temperature at which it volatilizes, and also on the medicinal effects aimed at.

Chloroform, ether, bichloride of methylene, and nitrite of amyl evaporate at ordinary temperatures, and only need to be diluted with air to be safely inhaled. Calomel and sulphur are sublimed at high temperatures in special apparatuses; but the majority of drugs are best vaporized through the medium of hot water or steam, or reduced to fine spray by passing compressed air through their solutions.

Many forms of inhaler are in use, but in selecting one for warm inhalations the requisites are:—(1) that it can be used without difficulty by the patient; (2) that a temperature of 130° to 150° F. can be steadily maintained; (3) that the steam be thoroughly impregnated with the medicament; and (4) that the inhaling tube be fitted to the nostrils as well as to the mouth, so as to ensure a sufficient supply of the inhaled vapour. When no inhaler is at hand, a jug with a wide mouth and half filled with hot water may be used, a towel being placed round between the mouth and nose of the patient and the opening of the jug, to prevent the escape of the vapour into the air.

Varieties and Uses.—Inhalations are employed chiefly in diseases of the pharynx, larynx, and air-passages, and may be classed as *sedative*, *stimulant*, and *antiseptic*.

Sedative.—Steam is soothing to the throat,

when this part is dry, inflamed, or irritable. In incipient laryngitis and croup, as well as in irritable bronchitis, the inspiration of steam from specially arranged kettles is very grateful, the moist vapour promoting secretion and expectoration.

Jets of steam are used in hospitals and bath establishments as vehicles for the inhaled drugs, and are directed into the patient's mouth.

As sedatives the vapor conii and the vapor acidi hydrocyanici are recommended in cases of laryngeal or pulmonary irritation. A sedative inhalation made of equal parts of chloroform and rectified spirit—of which one teaspoonful may be added to a pint of water, at 60° to 100° F.—is much commended in hay-fever and laryngeal spasm. A combination of chloroform and conium, in the proportion of 15 minims of the former to 1 drachm of the succus conii, in half a pint of boiling water, is useful in phthisis and some forms of asthma.

Stimulant.—Stimulating moist inhalations can be prepared with various volatile oils. Oils of pine and of cubebs are useful stimulants in cases where there is much secretion from the throat and air-tubes. Thus 2 drachms of oil of pine or oil of cubebs may be mixed with 60 grains of light carbonate of magnesia in 3 ounces of water; and of this mixture 1 drachm may be used in a pint of water at each inhalation. One drachm of the compound tincture of benzoin, in half a pint of hot water, is often useful in chronic bronchitis and laryngitis. Oil of turpentine or of pinus silvestris (1 drachm to the half-pint of hot water) makes excellent stimulant inhalations in cases of dilated bronchi.

Antiseptic.—Antiseptic inhalations are used where the object is to correct a fœtid secretion, as well as to stimulate the secreting membrane to fresh action. In fœtid bronchorrhœa, in gangrene of the lung, in fœtid abscess, and in pyopneumothorax, benefit is derived from the vapor creasoti, the vapor iodi, or from glycerine of carbolic acid (from 2 to 3 drachms to the pint of boiling water), or again from oil of thymol, prepared like the other essential oil vapours, with light magnesia and hot water (10 grains to the 3 ounces). The fumes of nitre paper are employed as inhalations in cases of pure spasmodic asthma uncomplicated with bronchitis. The paper—prepared by soaking white blotting-paper in solution of nitrate of potash—is sometimes washed over with tincture of benzoin, and this, in certain cases, may be an improvement; but in ordinary forms of asthma the nitre paper (30 or 40 grains of nitrate of potash to 1 ounce of water to form the solution for soaking the paper) burnt till the patient is enveloped in smoke, will usually relieve the asthmatic paroxysm. The fume of a grain of powdered opium volatilised on hot metal has been praised as a remedy to cut short nasal catarrh; as well as smoking solid opium in the Chinese fashion through a pipe, in spasmodic asthma. Cigarettes and pastilles containing stramonium and other antispasmodics, are sometimes used with benefit.

Atomised inhalations of spray have of late years come into deserved repute as valuable aids to the treatment of chronic diseases of the throat and lungs. The principle of the hand-ball and steam-spray atomisers is, that if two capillary tubes are placed at a certain angle to each other, one dipping into a fluid, while through the other a stream of air is driven by heat or compression, a vacuum is formed in the first, causing the liquid to pass out in the form of fine spray. In using these instruments, the operator should seek to blow the spray into the patient's throat at the time when an inspiration is being taken, as thus the spray will obtain a free entrance through the larynx into the trachea. It is doubtful if much spray enters the air-tubes; some certainly does, as has been stated above, but the cold sprays do not appear to afford so much relief to affections of the lungs as the warm inhalations. In cases of tumidity of the larynx, a spray containing 10 grains of alum to 1 ounce of distilled water may be used. In place of alum, 2 grains of sulphate of iron, 5 grains of sulphate of zinc, or 5 grains of dry chloride of iron, in 1 ounce of water, may be employed. For antiseptic purposes, 5 minims of sulphurous acid, or 1 minim of carbolic acid, to 1 ounce of water, or a like quantity of liquor iodi may be used. In putrid sore-throat and diphtheria the writer has seen excellent results from iodine, either inhaled in vapour or applied in solution. Three and a half drachms of lactic acid in 10 ounces of water form a solution which, thrown as spray into the throat, is of use in diphtheria; it seems to dissolve the exudation. As a styptic and hæmostatic spray 50 to 200 grains of tannic acid are employed, dissolved in 10 ounces of water, but for relaxed throat a weaker solution is useful. For sedative purposes a solution of bromide of ammonium, or one containing half a grain of acetate of morphia to 1 ounce of water, may be employed. Diluted ipecacuanha wine spray is said to be very efficacious in relieving the dyspnœa of chronic bronchitis and emphysema. This spray in a few instances may induce vomiting, but this accident may be obviated by diluting the wine with a considerable proportion of water. At the Continental spas it is usual to medicate large chambers by means of sprays and vapours, in which patients can sit for hours breathing the artificial atmospheres; and in this way various mineral waters, such as those of La Bourboule, Aix-les-Bains, and Cauterets are locally applied.

JOHN C. THOROWGOOD.

INJECTION (*injicio*, I throw in).—SYNON.: Fr. *Injection*; Ger. *Einspritzung*.

DEFINITION.—Injection is the act of introducing a fluid into any part of the body, by means of a syringe or similar apparatus. The word is also employed to designate the fluid so introduced.

VARIETIES.—Injections are chiefly used in the treatment of disease; but reference must also be made to the method as it is practised by anatomists for the preservation of 'subjects' for dissection; and for the purpose of filling the blood-vessels, lymphatics, ducts, cavities, spaces, &c., preparatory to microscopical examination.

The therapeutical application of injections comprehends the following measures:—

1. *Hypodermic* or *subcutaneous* injection, in which the fluid is injected under the skin. *See* HYPODERMIC INJECTION.

2. Injections into the natural *canals* or *open*

cavities of the body; for example, the external ear, the Eustachian tube, the nose, the nasal duct, the stomach, the rectum (*see* ENEMA), the urethra, the bladder, and the vagina and uterus. The various forms of injections just indicated will be found fully discussed under the diseases of the several organs.

3. Injections into *shut sacs*, normal or morbid; such as the tunica vaginalis, the serous cavities, the synovial cavities, the sheaths of tendons, and cysts and chronic abscesses. The fluids used in this class of injections are generally stimulant, such as a solution of iodine. *See* HYDROCELE.

4. *Intravenous* injections, the fluid introduced into the circulation being either blood (transfusion), milk, or some kind of nutritive solution. *See* TRANSFUSION. J. MITCHELL BRUCE.

INOCULATION (*in*, into, and *oculus*, a bud, a graft).—As usually understood, inoculation is either an operative procedure or an accidental occurrence, by means of which morbid materials are brought into direct contact with the minute vessels of the skin or of a mucous membrane, or with those of the subcutaneous or submucous tissue, so that they are readily and speedily absorbed, the result being that they originate certain definite and specific diseases, varying with the nature of the material employed. In short, inoculation, as commonly practised or observed, is a mode by which the contagia of certain specific diseases are conveyed from one animal or individual to another; and some of these affections can only be thus transmitted, while others are capable of being communicated in other ways, but in this way most effectually and with the greatest degree of certainty. The most familiar examples of diseases thus transmitted are vaccinia, small-pox, syphilis, and hydrophobia. It need hardly be mentioned that vaccinia can only be conveyed by inoculation, and it is for the purpose of inducing this disease that the method is ordinarily intentionally practised, so that the terms *vaccination* and *inoculation* have come to be popularly regarded as synonymous (*see* VACCINATION). Under certain exceptional circumstances inoculation of the contagious matter of syphilis, small-pox, or anthrax is employed, with the deliberate purpose of originating these affections (*see* SMALL-POX; SYPHILIS; and PUSTULE, MALIGNANT). This plan has also been practised of late years in experimental pathology, by which the effects of the inoculation of septic liquids upon the system have been demonstrated; while it has also been shown that the introduction of certain solid morbid products in this way may originate an infective process, leading to definite pathological results. *See* CONTAGION.

With regard to the modes by which inoculation is effected, it need only be said here that when it is practised as an operation, the material is usually introduced into the subcutaneous or submucous tissue, by means of a lancet or other pointed instrument. Sometimes the surface of the skin is merely scarified, so that the epidermis is more or less destroyed; or this is removed by some blistering agent, and the contagious substance then applied to the exposed cutis. Accidental inoculation may take place in connection with any abrasion, wound, or ulcer on the skin or on a mucous surface; or by the bites of animals, as in the case of hydrophobia.

FREDERICK T. ROBERTS.

INSANITY. — SYNON.: Fr. *Folie*; Ger. *Geisteskrankheit; Geistesstörung.*

Insanity is popularly known as disorder of mind: as physicians, we know it to be disorder of the highest organs of the nervous system which unite in the performance of that function recognised and spoken of as mind. There can be no disorder of mind without disorder of brain: as physiologists and pathologists we have to study and treat the latter, and for this reason the legislature enacts that certificates of insanity shall be given by medical men, and by them alone, and that to their care shall be committed those who are insane.

As a preparation, then, for the study of insane mind, the learner ought to acquire a knowledge of healthy mind—the healthy function of a healthy brain. He must know what are the structures which combine to make up that which we call the cerebrum, and contribute to its healthy working, and must trace the growth and development of this working from the earliest days of infancy to the time of adult life. He will perceive that the growth of mental function is as gradual as that of bodily power; that in some it may be more rapid than in others, like that of the body; that it may be arrested in its development, or stunted and deformed; and that it may by imperfection of the organs, as blindness or deafness, be impeded or stopped. In all particulars it will be found subject to the laws which regulate the growth of the body generally.

Before examining brain-function, it will be necessary to become acquainted with the various structures which form the cerebrum. The brain of man, and indeed of all vertebrates, is made up of nerve-cells and nerve-fibres; of a substance or *stroma* in which the cells are imbedded, called neuroglia; and of blood-vessels and lymphatics. The nerve-cells are gathered into convolutions or *centres*; and by means of the nerve-fibres communicate with the organs of special sense, with the sensory ganglia and spinal cord, with each other, and with the convolutions of the other hemisphere. Modern science is endeavouring to throw light upon the nature and uses of these convolutions. The seats of the highest intelligence, they at the same time appear to be centres of voluntary motion, and of the outward manifestation of intellectual action.

Concerning the physiology of the blood-supply of the brain there is still great doubt and controversy. Anatomically we know that from the internal carotid and vertebral arteries, combining in the circle of Willis, there pass to the brain-substance the anterior, middle, and posterior cerebral arteries. The terminations of these ramify in the pia mater, and thence send many small vessels to the grey matter, and fewer, but larger ones to the white, the supply of blood to the former being much the more plentiful. That, however, which chiefly concerns the student of insanity is the vaso-motor system of nerves which controls and regulates the blood-supply. Modern research appears to render it more and

more certain that the condition of insanity, at any rate in its early and acute stage, is mainly one of increased blood-supply. On what does this depend? To this question no precise answer can as yet be given. Investigations are still being made as to the nerves which dilate and contract the vessels; but with regard to this subject, and the so-called inhibition of nervous influence, much more must be ascertained before the pathology of insanity can be definitely fixed. The lymphatics of the brain are also, according to some observers, largely concerned with the disturbance of mental function, if it should happen that by being blocked up or impeded they fail to carry off the waste products of the organ. They are contained in perivascular lymph-spaces, lying between the outer fibrous coat of the blood-vessels and a hyaline membrane or sheath of pia mater which separates them from the brain-substance.[1]

Even concerning the neuroglia, controversy exists. Is it merely connective-tissue, or is it nerve-structure? Authorities lean to the former view, and the increase of it in diseased brains seems to point to a growth of lower structure at the expense of higher.

Passing to the functions of the brain, the phenomena comprised under this name are of two kinds. There are the various movements excited by the stimulation of the different brain-centres, on which the experiments of Dr. Ferrier have thrown new and interesting light. But these are not the phenomena of mind. The latter can only be studied by observation of a totally different character. For mind implies sensation, feeling, consciousness; and as we have no consciousness of any feelings but our own, it is evident that here objective observation is insufficient, however unwilling physiologists may be to admit it. Yet the subjective examination of ourselves is as inadequate by itself to explain the phenomena of diseased mind, as objective observation is to make known the nature of mind in general. We must use the subjective method as our key, and by means of it open up and interpret the phenomena of mind: we may then objectively examine the mental characteristics, the growth and development, the diseases and decay of mind in all human beings, children or adults, idiots or insane, and by tracing thus the effects of injuries and disease, we arrive at a knowledge of the differences between sound and unsound mind.

By observation of the movements brought about by nerve-function, we perceive that they follow the application of a stimulus, and that many actions take place in response to stimuli which we call reflex, instinctive, or automatic, before those begin that are the product of mind in its highest sense. For mind grows slowly and gradually. The first movements of the child, reflex or instinctive, are the result of stimulation of nerve-centres, but are only slightly, if at all, attended by consciousness. This becomes appreciable later, and with it the commencement of *memory* and *ideas*, as the feelings roused by stimulation are stored away in the mind, to be reproduced as some new stimulus is presented to them. The various brain-centres are in this manner stored with ideas, the result of experiences derived from without, and by means of the nerve-fibres they are united in groups till a most complex system is evolved. The sensations are developed into more and more complex feelings, till the highest emotions of civilised man are reached; and in a similar manner the intellectual processes grow from mere perceptions and cognitions to the highest trains of thought. Mind may be said to be made up of feelings and the relations between feelings, for the intellectual element of mind is the relational element, and it will be found that we cannot locate in two parts of the brain the emotions and the intellect, as some physiologists have proposed; for no kind of feeling, sensational or emotional, can be wholly free from the intellectual element; and on the other hand it very rarely happens that any act of cognition can be absolutely free from emotion.[2]

For the growth of healthy brain and mind all the conditions of physical health are necessary. If at birth there is inherited defect or accidental injury, or if at any subsequent period development is arrested or perverted, idiocy or imbecility is the result. There will be an imperfect recording of the experiences of life, an inability to learn, and a deficient power of bringing into relation one with another the various groups of nerve-centres which make up the brain, and are the seat of mind.

If, however, growth and development have proceeded normally, and normal mind is the result, what are the conditions of insanity, or disorder of mind? What are the conditions of healthy and unhealthy brain-function?

I. We know by experiment on nerves and nerve-centres, and by observation of the objective phenomena of motion, that a discharge of nerve-force or nervous fluid—call it what we will—is liberated when a centre is stimulated, and that this ramifies according to its quantity in various directions throughout the system. When there is health and vigour the supply will be large, and every channel both in the brain and body will be duly supplied. But in the healthiest nervous system there must in time be a cessation of this discharge, for in time the supply will be exhausted, and repair and replenishing must take place. And unless this is done, nerve-function will be impaired or cease. For the repair of the higher nerve-centres sleep is necessary, for only during sleep is the repair of the waste effected, and we commonly, nay, constantly find, that mental disturbance is preceded by loss of sleep.

In some cases want of sleep may depend on the actual time allowed for it being insufficient. Though not a very common cause of insanity, yet it sometimes is found in persons who are very hard-worked, or who, by religious exercises and services, deprive themselves of sleep. In the great majority, however, want of sleep is the result of a pathological condition of the brain, a condition which by appropriate treatment the physician seeks to remedy as the first step towards the cure of the insanity.

[1] Dr. Batty Tuke. Morisonian Lectures. *Edinb. Med. Journ.*, Dec. 1874.

[2] Herbert Spencer, *Principles of Psychology*, vol. i. p. 473.

Not only may there be a want of repair and replenishing of the nerve-force expended, but there may be also a defective generation and supply of it. Through anæmia or exhaustion from acute diseases or long-continued illness, the nerve-centres fail to generate from the blood the power necessary for their due operation. The discharge liberated does not ramify throughout the nervous system, calling into action every part of the brain, and penetrating to every portion of the muscular structures; thus the failing supply is manifested in the gloom of *melancholia* and the slow and torpid movements which accompany it; and when it is reduced to a still lower ebb, there may be not enough to carry on even the semblance of mind: the patient presents the appearance of utter fatuity seen in *dementia*, whether primary or secondary, and either sits motionless and lost in the condition termed *melancholia cum stupore* [Fr. *mélancolie avec stupeur*; Ger. *Schwermuth mit Stumpfsinn*] or executes the purposeless and automatic movements of acute dementia [Fr. *Démence aigué*].

The defect of nerve-force may bring about insanity in more than one way. A sudden strain or shock may make an unwonted demand upon the nervous supply. Incessant thought, especially of a painful kind, may use up the reserve of force: this is not renewed, and insanity is the result, the increased molecular discharge not being duly compensated by an increased supply from the nutritive sources. Secondly, the supply may fall so far below the standard that it is not sufficient for the ordinary demands of every-day life, and so, without any mental cause, but simply from nerve-inanition, the stage of depression appears. In both of these cases, however, as in all recent insanity, the brain is in a state of hyperæmia, as evidenced by heat of head, want of sleep, and often pain and congested appearance of face. The hyperæmia impedes healthy nutrition and causes sleep to be absent, but it is erroneous to say that the brain in such patients is in a state of anæmia, even if the general bodily condition deserves that name.

II. It may be, however, that there is not so much a defect of nerve-force, as an unstable condition of the cerebral centres, which is manifested by a rapid and continuous discharge. Such a discharge in a more sudden and violent form we are familiar with in the phenomena of epilepsy. In insanity it may vary from undue hilarity and excitement up to the incessant movements and vociferation of acute delirium; and like epilepsy it may terminate in exhaustion, coma, and death. The supply of nerve-force in such cases is often abundant. The patient goes without sleep for days and nights, and yet recovers. The higher brain-centres lose the power of control, owing to the violence of the discharge, and the lower and more automatic centres thus liberated are stimulated to overaction, which is manifested in noisy and violent delusions, and so on to mere delirious incoherence. And after the discharge has ceased, there may be a period of dementia and complete obliteration of mind, before the exhausted brain begins to recover. Persons who are in this condition of unstable nerve-equilibrium may be thrown off their balance by mental causes—by shock, or grief, or losses. Their brain may also be affected by disorder of the other organs of the body *sympathetically*. In all such patients there is a predisposition, often inherited, to nervous instability and rapid discharge, and such 'causes' as puberty, pregnancy, or child-birth bring about an explosion. Here, too, there is marked cerebral hyperæmia, producing an abnormal nutrition and corresponding abnormal function.

III. Disturbance or defect of mind may be caused by incomplete development of any part concerned in mental action, or by the presence of anything within the cranium which interferes with the healthy life of the various organs. There may be tumours of different kinds, or abscess. Insanity also follows blows on the head; and deterioration of brain is frequently caused by the action of alcohol and other poisons. In all these cases we have not a functional disturbance which may suddenly arise and as suddenly pass away, but a gradually organized lesion which usually advances, producing serious and permanent results. The degeneration of the organ and tissues through age will also produce corresponding results.

Symptoms.—What are the symptoms of insanity, and how far do they correspond to the pathology of brain-disturbance as set forth in the above remarks?

The first symptom usually noticed in a person becoming insane is an alteration in his *emotional* condition. Either he is more quiet and dull than usual, or, on the contrary, more restless, irritable, excitable, or hilarious. The dulness may vary from a mere disposition to sit still, and neglect his work or amusements, to actual gloom and despondency. The restlessness and excitement may also vary in degree, and be accompanied by gaiety or outbursts of anger and violence. The change may be more or less concealed, according as the patient can or cannot control himself. Those of his own family or people about him may notice it long before others, and this stage will vary in duration, often lasting some time before delusions or other marked symptoms are discoverable.

The *acts* of the patient will correspond to his altered feelings. His relations towards the outer world will be altered. In his torpor or gloom he will look on everything despondingly; will be unable to perform his duties, will not care for amusements, will sit at home inactive, or take up morbid fancies about his health. Conversely, he will act rashly in matters of business, embark in foolish speculations, take no heed of time or appointments, spend money recklessly, indulge in debauchery or frivolous pursuits, show causeless anger to those about him, or exhibit silly and childish hilarity when matters of grave moment are pending.

Here we have a *slight insanity*. The higher brain-centres are but slightly disturbed, and still exercise a considerable amount of control over the lower and less specialised centres. It may be difficult to say that any one act or feeling is of itself indicative of insanity, but the patient is a changed man, and the term *moral insanity* is specially applicable to this condition.

Such an insanity may remain and be permanent: more frequently, however, it either passes

off, the patient recovering, or advances in one or other of the directions already indicated. The gloom will increase; corresponding delusions will present themselves with appropriate acts and conduct; and the patient will drift into *melancholia*. Or he will become more and more hilarious, angry, excited, or suspicious, and a state will arise to which for want of a better we give the name of *mania*. Though delusions are not usually found in the stage of alteration, they are seldom absent in the second and more advanced period, and generally correspond to the feeling of the sufferer, so much so that the appearance and humour frequently enable us, without previous information, to arrive at the delusions under which he is labouring. This stage is often called *intellectual insanity*, or insanity with delusions. Patients labouring under one or other of these forms vary in the degree of insanity, from a condition in which they are able to talk coherently on many topics to one of complete incoherence or delirium. To the former the name of *partial insanity* is often applied.

Another condition is that of fatuity or childishness in various degrees. It may come on rapidly, the patient passing at once into this state, which is then called *acute* or *primary dementia*; or it may be the result of years of insanity or brain-disease, and is termed *chronic* or *secondary dementia*. In such people we find loss of memory, inability to revive the relations of feelings and ideas—not emotional disturbance, but rather an absence of all emotion.

As regards the bodily symptoms, almost every variety of insanity is ushered in by sleeplessness, sleep being deficient or altogether absent, perhaps for days, according to the acuteness of the attack. This indicates a disturbance of the brain-circulation, which is also shown by heat and pain of head, injection of the conjunctivæ, and throbbing of the carotids. There may be excessive vascular action even when the insanity is the reverse of what is sometimes termed sthenic,' and the general condition of the patient is one of anæmia rather than hyperæmia.

It has been said that the mental symptoms of insanity are accidental, that they do not indicate the pathological conditions, but depend on the state of the body, and that no classification of the forms of the disorder ought to be based on them. But it is perfectly certain that the brain of a man suffering from melancholia differs altogether from that of one in acute mania. In the former there is a scanty generation of nerve-force, which is insufficient to reach the remote channels and plexuses of the brain. There is not a general incoherence and confusion of ideas, and the patient can converse rationally on many topics. His feelings are those of pain and not of pleasure, because pains in general are more intense than pleasures in general,[1] and the former are evoked into consciousness by the feeble nerve-currents, while the latter are not. In what is termed mania we may have every shade of feeling displayed, from gloomy and suspicious irascibility to great hilarity. Feelings of anger and resentment are called up without the controlling power of reflection and judgment, such as would prevail were the whole brain at work, and the higher faculties and feelings co-operating and in relation with the lower. This, again, may be due to a want of nerve-force, or more frequently to an undue expenditure of it, as may be seen in the irritability of an over-tired child. What we may call the more automatic and less complex feelings of fear and self-love are evoked, while there is not force and pressure enough to supply the rarer and more remote qualities of comparison and reasoning which require the combination and union of the highest portions of the brain. If there is an increased and accelerated blood-flow, great hilarity and self-satisfaction may be the result, yet with perfect incoherence of ideas, owing to all the relations of the brain-plexuses being interrupted by the tumultuous or impeded circulation, and the excessive nervous discharge. And in dementia the very opposite may be witnessed. The supply of force is reduced so low that there is an absence of all ideas; memory, at any rate of recent events, is lost, and only the well-marked occurrences of earlier life are recalled.

That the mental symptoms are to be by the pathologist altogether disregarded, and that they are of no assistance in the appreciation of the pathological condition, seems a most extraordinary assertion. These symptoms do not depend on the state of the body generally, but on that of the brain, and as accurately indicate the condition of the latter as the breathing indicates that of a lung. The brain in insanity is the *pars affecta*, the insanity is the symptom, and when we see in the same individual at one time mania and at another melancholia, we may be sure that the condition of brain at the one period is not the same as at the other, though originally one cause may have lighted up the malady.

Diagnosis.—Accuracy of diagnosis is specially important in insanity, owing to the legal and social results which flow from it, and because the restrictions on liberty which may be necessary for proper treatment cannot be resorted to until a diagnosis has been conclusively established. The direction of the investigation will be different, according as the condition may be the result either of incomplete development, or of disablement or perversion by disease. Where *imbecility* is in question, it may often be necessary to take several opportunities of examining the patient. This condition always implies intellectual defect, though great moral depravity is often the predominant symptom. It is therefore necessary to ascertain whether any or what kind of occupation has been attempted, and what amount of incapacity has been shown, and whether the individual has proved capable of profiting by such education as he has received. Adults in ordinary circumstances ought at least to be able to read, write, and count. The decision rests on whether such capacity has been shown as is required in the ordinary conduct of life. To form a correct opinion in cases of *acquired insanity* is often a very difficult matter. The relatives of the patient often obstruct rather than aid the enquiry. They are generally divided in opinion, and this may be partly an aid and partly an

[1] *See* Herbert Spencer, *Principles of Psychology*, vol. 1. p. 602.

obstruction; but great care is required to avoid taking part at first with either side. Before seeing the patient it is proper to make what inquiry is possible into the hereditary history of the family, the nature of the diseases or injuries from which the patient may have suffered, including any previous attacks of insanity. The ordinary habits, disposition, tastes, and occupations must be ascertained, and also the present habits, disposition, tastes, occupations, amount of sleep, and general bodily health. The mental symptoms, such as suspicions, delusions, or loss of memory, which have suggested the allegation of insanity, must also be inquired into; and special attention must be paid to any indication of the change of conduct or disposition which is so characteristic of the advent of mental disease. A reference to the articles descriptive of the forms of insanity will show the importance of all these points. In the whole investigation care must be taken to avoid accepting mere *ex parte* statements, and as much information as possible should be obtained by the inspection of letters or other documents written by the patient. Sometimes the conduct of the patient renders it difficult to obtain an interview, and care must be taken not to overstep legal limits in the attempt. If the physician has to see the patient in the presence of other persons, it is a necessary precaution to make certain that he clearly understands whom he is to examine. In obtaining the interview a certain amount of stratagem may sometimes be resorted to; but it is best that the physician should be introduced by a friend in his true character as a doctor, and on no account should any false statement be made. As a mere matter of expediency it will be found that any deviation from this produces more evil than good. If the interview takes place in the patient's home, valuable information may frequently be obtained by observation of the order or disorder which prevails. The condition of the furniture, the state of the patient's clothing, the manner of the patient towards the rest of the household and their bearing towards the patient, ought to be noted. The patient's physiognomy, the condition of the pupils, and any gesticulations or convulsive or tremulous movements, must be observed. In conversation it is well to get as soon as possible to the subject of the patient's health, as it relieves many necessary questions of their offensive character. Eccentric ideas ought not to be combated more than may aid in making the patient disclose them fully; and everything tending to show the presence or absence of delusions, irrational suspicions, or loss of memory, ought to be elicited. Many other points will probably be suggested by the course of each inquiry; and the importance to be attached to them, as well as to those just mentioned, must be decided by a careful study of how far they are included or excluded by the known symptoms of any of the various forms of insanity.

Ætiology.—We now pass to the causes of insanity, which are usually spoken of as *predisposing* or *exciting*: in many cases both combine in the causation of the disorder.

The great *predisposing* cause is an inherited disposition to neurotic disorder—one difficult to estimate and, indeed, to discover, owing to the care with which it is concealed, but the importance of which cannot be questioned. It has been adverted to in the second section of the pathological conditions, and will again be noticed. *See* Insanity, Varieties of.

When we speak of such predisposing causes as *sex*, *age*, and *condition of life*, it is evident that they can only be called causes in the sense of being concurrent conditions, in some of which a man or woman is more likely to become insane than in others.

Has *sex* anything to do with insanity? Referring to statistical tables we find that in the Report of the English Commissioners in Lunacy for the year 1874 there were under treatment in asylums at the end of the year 1873, 18,872 males and 20,741 females. There were admitted during the year (not reckoning re-admissions or transfers) 6,264 males and 6,347 females, while in the same period there died 2,288 males and 1,705 females. The preponderating number of females under treatment is probably due to the fact that the mortality among them is far less than among males, and consequently they accumulate in asylums. The difference in the number of the two sexes who become insane is probably not material, but it seems that the males are the larger number, or, looking at the difference in the mortality, they would fall below the number of the females further than they do.

With regard to *age*, we find that the tendency to insanity increases with the development of brain and mind. In the first decade of life it is rare. In the second, which includes the period of puberty, it is more common, but not so much so as in the next. The period between 25 and 40 years is that in which the greatest number of cases arises, and is that of the highest development and working power. After this the number declines in each decade, as before it rose. With the age the character of the insanity varies. In youth it is displayed in violent and paroxysmal mania, sometimes in acute dementia, and cataleptoid states. There is great motor disturbance and emotional rather than intellectual aberration. Rarely are the young melancholic. In the prime of life there is active mania with delusions and intellectual insanity, and at this period we meet with the most acute forms. Later, melancholia prevails; while in old age weakness of mind, passing into fatuity and second childhood, indicates the general decay of the brain and nervous system.

As to the *condition of life* in which insanity is most frequently found, there is not much to be said. That it occurs more frequently in civilised than in barbarous countries may be assumed without recourse to figures, because in the former mind and brain are more complex, and therefore more prone to disorder. It is, however, the failures and vices of civilisation that bring about the great mass of insanity. And of these the chief is *poverty*, with all its attendant physical evils of insufficient food and wretched dwellings, and moral evils of anxiety and degradation. Next to poverty, and closely bound up with it, is *drinking*, which among the working classes plays a fearful part in the causation of the disease. Among the predisposing causes of insanity included by the Interna-

tional Congress of alienist physicians in 1867 are, besides those already enumerated, consanguinity; great difference in the age of the parents; influence of the soil and surroundings; convulsions or emotions of the mother during gestation; epilepsy and other nervous affections; pregnancy, lactation, menstrual periods, critical age, puberty, venereal excess, or onanism. We may add to these, damage received at birth owing to difficult parturition.

The *exciting* causes of insanity are usually divided into *moral* and *physical*. Among the former we may reckon domestic trouble and anxiety, mental shock, overwork, religious excitement, political excitement and war, and disappointment. Concerning such little need be said. They may vary in duration, some quickly bringing about insanity, others persisting for years before that result is reached. For the most part those who are affected by such causes are already predisposed by hereditary taint, by a neurotic temperament, or by being at one or other of the critical periods of life.

Among the *physical* exciting causes are some which are both exciting and predisposing—for example, intemperance and epilepsy. These may be the immediate precursors of an attack; as well as agents causing a predisposition to the disorder, by being repeated through a series of years. Other physical causes are parturition, menorrhagia, amenorrhœa, and various other ovarian and uterine ailments; diseases and injuries of the head; acute febrile diseases and chronic illness, producing exhaustion; constitutional diseases, as gout, ague, or syphilis; disease of heart and vessels; exposure to great heat or cold; lead and other poisons; anæmia; blows on the head, and organic affections of the bones of the cranium, or the various parts contained therein.

Classification.—Almost every writer on insanity has suggested a special classification of its forms, and the majority have founded their suggestions either on the ætiology or symptomatology of the disease. Of those based on symptoms none is simpler than Griesinger's:—(1) states of mental *depression*; (2) states of mental *exaltation*; (3) states of mental *weakness*. He placed general paralysis and epilepsy apart as mere complications of insanity. His groups, therefore, correspond broadly with the old divisions of *Melancholia*, *Mania*, and *Dementia*. The ætiological classification most widely known is that of Morel. He divides the forms into six:—(1) *Hereditary* insanity, including congenital nervous temperament, moral and impulsive insanity, imbecility, and idiocy; (2) *Toxic* insanity, including conditions caused by insufficient or injurious food, poisons, or noxious air or water; (3) *Hysterical*, *epileptic*, and *hypochondriacal* insanity; (4) *Idiopathic* insanity, dependent on disease of the brain or its membranes; (5) *Sympathetic* insanity; and (6) *Dementia*, or the condition of terminative enfeeblement. For any systematic study of the subject, it is obvious that some symptomatological grouping, based on the characters of the mental manifestations, must be necessary. It has, however, been maintained that it is impossible, either on this or on a purely ætiological basis, to found groups which have more than an artificial relationship to one another. And there is some truth in this criticism. But, though the ties which bind the psychological groups together may be in a sense regarded as artificial, it is found in practice that the associated conditions exhibit a considerable amount of intimate natural connection.

At the International Congress of Alienists in 1867 the following classification was laid down, intended to combine the ætiological and symptomatological methods:—1. *Simple Insanity*, comprehending mania, melancholia, monomania, circular insanity, moral insanity, and the dementia following these forms. 2. *Epileptic Insanity*. 3. *Paralytic Insanity*. 4. *Senile Dementia*. 5. *Organic Dementia*. 6. *Idiocy*. 7. *Cretinism*.

The first class, it will be observed, comprises all the varieties which may be regarded as merely functional; the others are mostly associated with permanent structural lesions.

No classification which has been proposed can be regarded as altogether satisfactory. This is partly owing to the fact that the true nature and limits of insanity itself have been very imperfectly recognised. The essence of the condition is, of course, the manifestation of disease through some deviation from the healthy standard of mental action. It is a condition of mental unhealth analogous to bodily unhealth. But we must not allow ourselves to imagine that there is a class of morbid mental manifestations which are independent of the condition of the physical frame. The truth is that there is no pathological condition of the individual in which both mind and body are not affected; but in some diseases the mental symptoms come into prominence, in others the physical. The notion, not yet altogether exploded, that there is something in insanity altogether distinct from bodily disease, arose from the belief so long prevalent that mental action is independent of physical conditions, and from the fact that the study of insanity has been and still is too much dissociated from the study of the rest of cerebral pathology. Acting upon the broader and truer views, attempts have been made by Schroeder van der Kolk, and others, to introduce a more natural system of classification. Such attempts have proceeded on the recognition of all mental symptoms as phenomena whose nature cannot be ascertained without a full consideration of the physical symptoms of disease by which they may be accompanied. Dr. Skae proposed a classification based on the belief that every mental disorder bears a relation to some bodily disease—acute or chronic—analogous to what the delirium of fever does to the fever in whose course it is manifested. The detailed list which he offered was, however, admittedly imperfect; and it is likely that any satisfactory classification on this principle will only be arrived at after a much closer study of the mental symptoms of disease than has yet been given to them. But Skae deserves the credit of having given the most powerful impulse to the purely medical, as opposed to the metaphysical, mode of studying insanity. In furtherance of this, some progress has been made by Clouston, Batty Tuke, and others, who have published careful monographs of some of the more prominent forms. If by such means we

can group together conditions which are similar, not only in their mental but also in their physical characters, we obtain units which may ultimately contribute to the building up of a more perfect system, and which can never be altogether disregarded by classifiers in future. Most of the attempts which have been made to describe such groups must at present be regarded rather as valuable suggestions than as well-established clinical and pathological species. For the purposes of this work it has been considered best to describe in the present article, the various phases of insanity which have been regarded as of special importance, without regard to the principles which underlie their conception; and afterwards to discuss the various well-marked forms of the disease under their several heads, alphabetically arranged.

Prognosis.—The general prognosis of insanity will depend (1) on the duration of the existing disorder. Perhaps the best established fact of all is, that the chances of recovery diminish in direct proportion to the duration of the malady, and that it is consequently of the utmost importance to place a patient early under adequate and appropriate treatment. If a twelvemonth elapses without appreciable improvement, the chances are decidedly unfavourable. If delusions or hallucinations remain fixed and unchanged at the end of a year, especially if there be hallucinations of hearing, the prognosis is bad. The chief exception is where there is marked melancholia. Patients will recover from this after long periods; whereas such recoveries are seldom found in insanity when depression is absent. (2) When the cause of the insanity has been of long duration, the prognosis is less favourable than when it is a passing or accidental cause. (3) Is the prognosis unfavourable in hereditary insanity? So much of the so-called simple insanity is hereditary, that we must admit that recoveries from it are not infrequent, for it is from this simple insanity that recoveries chiefly take place. Hereditary insanity is brought about by very slight exciting causes, and thus the prognosis is often favourable, and recovery takes place; but relapse is to be feared, and the prognosis in a second or third attack is not nearly so good. In this hereditary insanity, too, we frequently meet with the cases of recurring and 'circular' insanity, the progress of which is most unfavourable. Both Ray and Griesinger have remarked that the prognosis in hereditary insanity is favourable only where the individual has previously been of normal mind. When he has always been eccentric or semi-insane, and undoubted insanity at last manifests itself, the prognosis is very bad. (4) The more acute the symptoms, the greater the cerebral disturbance and insomnia, the more favourable is the prognosis, if the case is recent. Conversely, the prognosis is bad when there is little bodily disturbance, where sleep is present, the appetite normal, and the secretions unaffected, especially if persistent delusions or an entire moral change are found. (5) As all deviation from the ordinary mental state and disposition is indicative of insanity, so any return to it is a favourable sign, however trifling the circumstances may be. (6) Improvement, however slow, is a good sign if it be progressive. So long as this goes on, recovery may take place; but many patients improve up to a certain point, and then go no farther. (7) The age of the patient must be considered. Young people recover in greater numbers than those advanced in life. The latter recover if their insanity be melancholia; but, if it be mania, with hallucinations and delusions, and obscene conduct and ideas, recovery is rare, especially if the memory is impaired, and signs of approaching dementia are present. (8) All periodicity in the disease, such as exacerbations and remissions on alternate days, is unfavourable.

Treatment.—Only a few general remarks on treatment will be offered here. Our objects should be to restore to health the disordered brain, to cause the incessant waste to cease, to promote a storing and not an expenditure of nerve-force. The brain must be nourished by healthy blood. The quantity of the latter when in defect must be increased; when its quality is in fault it must be improved; and when the blood-flow is in excess it must be checked; while all causes of disturbance reacting upon the brain from other organs of the body must be removed.

It is not to be forgotten that powerful effects are produced throughout the nervous system, both in the lower and higher centres, by what has been termed 'inhibition.' By the diversion of nervous action from one channel to another, considerable influence may be exercised.[1] Emotional excitement may be diverted into motor or intellectual channels; or, by other emotional stimuli, may be counteracted or arrested. Intellectual or ideational troubles may be diverted by emotional longings, or by counteracting intellectual pursuits. And for all this certain adjuncts are necessary. Painful emotional distress, with the idea of impending ruin, is perpetually fostered by the sight of the loved faces of wife and children: the patient must therefore be removed from them. Outbursts of anger are constantly directed against those most familiar, and delusions correspond. These must be abolished by his being placed among strangers. Great as is the need in many cases of medicinal treatment, it is not so universally demanded as is the removal of the sufferer to fresh surroundings. We try again and again, in apparently the most promising cases, to effect a cure at home, and we fail. The necessity for early treatment in insanity is dwelt upon by every writer; and the treatment, when insanity is once fairly established, only begins after the patient is removed.

The first questions to be solved are how the removal is to be effected; and to what place the patient is to be removed. In the majority of cases, especially in the case of the urban poor, no doubt can arise—an asylum is the only place open to them, because either the friends are poor and cannot afford any other plan of treatment, or are compelled to have recourse to the public asylums of the land. For many an asylum is necessary because the patient is dangerous to himself or others, or would incessantly struggle to escape from a less guarded dwelling. But

[1] Dr. Lauder Brunton, on Inhibition. *West Riding Reports*, iv. 179.

there are some patients who may be cured out of an asylum. Some recover from acute but transitory attacks of delirious mania very rapidly, much as do the sufferers from delirium tremens, and, if measures of safety can be taken, we may watch such for a few days and perchance they may recover without removal. Many persons at the very outset of insanity may by removal and judicious treatment be cured, if their friends will only open their eyes and acknowledge the threatening evil, and not wait, as they so often do, till compelled by circumstances to interfere. Such patients must not be sent abroad or out of reach, must not go alone, or without able or skilled companions. They may go from place to place, or to a friend's or medical man's house. Fresh scenes and faces, and the cessation of work or worry, will often effect a cure. But they must be people able to walk out in public thoroughfares, and to live in houses under ordinary precautions. Where they cannot walk in public, and cannot live in a house without its being converted into a prison, they ought to go to an asylum, where there are grounds for exercise, and where facilities for escape are not always suggesting attempts. Patients' friends constantly make a mistake: they keep the patient out of an asylum at the time asylum treatment would cure him, and send him there when all hope of cure is over, and when, as a chronic lunatic, he would be just as well off out of one.

With regard to medicinal treatment little need here be said. The drugs chiefly used in insanity are sedatives and narcotics. The writer has little faith in these, except for the purpose of obtaining sleep, and gives them only at night, except in the happily rare cases where life is in danger from want of sleep. To procure sleep no drug in his experience approaches chloral in value; and few are the cases where it is totally inefficacious. He has failed to observe the pernicious effects attributed to it by some writers, and the results both in severe and slight cases have been most satisfactory. In the melancholic and non-excited cases the preparations of opium are of great service, alone, or in combination with chloral. In excitement, bromide of potassium is valuable, alone, or in combination with chloral, Indian hemp, or henbane. Digitalis, alone, or with morphia, is highly spoken of by Drs. Robertson and Williams. Ergot of rye is efficacious, according to Dr. Crichton Browne, in recurrent and chronic mania; and the same physician extols the virtues of calabar bean in general paralysis.

Good and abundant food is an essential in the treatment of the insane: stimulants are required in many cases, particularly the depressed and anæmic forms, but in the opposite, though often useful, they in some cases produce or increase excitement, especially in the early stage. With the food tonics should be given, and those best suited are, in the writer's experience, the mineral rather than the vegetable, and chief of all the preparations of iron.

G. F. Blandford.

INSANITY, Morbid Histology of.—Up to the present time no definite and distinct lesion has been shown to accompany invariably any definite and distinct form of insanity, with the exception of general paralysis; it may, however, be considered an established fact that in every case, whether recent or chronic, a marked departure, or departures, from healthy conditions may be observed if properly sought for; but in what manner these lesions have influenced the character of the case in respect of its leading symptoms, mania, melancholia, or dementia, little as yet has been elucidated. Nevertheless, the nature of the morbid appearances is sufficient to account for perversion of functional activity, although we are unable to account for the peculiar nature of the perversion.

One great difficulty which presents itself to the mind of the cerebral pathologist is to determine whether the morbidities which are apparent on microscopic examination are of a primary or secondary nature, whether they have been efficient causes of insanity, or whether they are merely the results of mal-nutrition of the brain, and as such efficient causes of chronic lunacy. There exists an undetermined point in anatomy which, until settled, must leave the question to a certain extent open—that point is the presence or absence of cerebral lymphatics. When it is considered that the brain is an exceedingly active organ, performing many and various functions, and when it is further considered that it can obtain no vicarious aid in the performance of those functions—that it cannot, like the lungs, seek assistance from other systems—it must be at once apparent that the question of its possession of an overflow for getting rid of superfluous plasm and waste products is of paramount importance. Fohmann and Arnold demonstrated to their own satisfaction the existence of a system of lymphatics in the pia mater; and His, Obersteiner, and Boll believe that the pia-matral envelope of the cerebral arteries (hyaline membrane) exercises the function of a lymphatic duct. The very existence of such a sheath or envelope has been called in question, but comparatively slight study is needed to make its demonstration certain. Although differences of opinion exist as to its relations and manner of debouchement, we believe that it terminates by funnel-shaped openings into the spaces which exist over the sulci between the pia mater and the so-called arachnoid membrane. Kölliker[1] has pointed out that the connection between the pia mater and the arachnoid over the convolutions is so complete and perfect that only at parts, namely over the sulci, a distinct space can be shown to exist. It is questionable whether the arachnoid should not be considered to be merely the outer layer of the pia mater. The bearings of this point on pathological histology will be considered under the head of cerebral congestion; it would not have been alluded to were it not that it assists somewhat in the differentiation between primary and secondary lesions of the cerebral tissues.

In prosecuting the study of the morbid histology of the brain and spinal cord, two methods of investigation should be adopted:—1. The examination of the tissues in the fresh state; 2. The examination of the parts *in situ* by means of

[1] Kölliker's *Histology*, Old Syd. Soc. vol. i. p. 450.

sections made after submission of portions of nervous tissue to hardening agents. The condition of the constituents of the recent brain can best be observed by colouring small specimens with rosaniline. The modern method of freezing, and section by means of the microtome designed by Mr. Bevan Lewis, has rendered the investigation of histological brain-changes a comparatively easy task.

The Membranes.—The dura mater is, comparatively rarely, thickened by proliferation of its elements; the vessels are found to be irregularly dilated and tortuous, with thickening of their walls.

The arachnoid and pia mater are in such close anatomical relation on the convexity of the hemispheres, that they can be best described together. Between them, supported by a delicate connective tissue, lie the blood-vessels which dip into the sulci, carrying with them an investment of pia mater, which gives prolongations to accompany them when they pierce the cerebral substance, and forms the so-called hyaline membrane. Over the sulci are the spaces usually termed sub-arachnoid, which communicate with one another by conduits accompanying the vessels. The microscopic appearances of 'milky arachnoid' have not been thoroughly described; both membranes are often thickened, presenting a laminated appearance, and the connective tissue supporting the blood-vessels is considerably increased, as well as the pia-matral prolongations accompanying the blood-vessels into the cerebral substance, which loses its hyaline character, and becomes distinctly fibrous. Extensive but thin blood-clots are occasionally found between the arachnoid and pia mater, while more rarely extravasations of blood are found between the pia mater and the cerebral substance. Deposits of hæmatoidin often surround the vessels, and their coats are frequently hypertrophied. Crystals of triple phosphate have been seen on the visceral surface of the pia mater. Lymph has been found between the pia mater and the spinal cord; the membrane was thickened, and internal to it were numerous distinct laminæ of a finely fibrillated material, in some places $\frac{1}{200}$ of an inch in breadth. In one case there was long-standing epilepsy, in the other chorea, both being complicated by insanity.

The Epithelium. — The ground-glass appearance frequently seen in the ependyma of the ventricles is due to three different morbid conditions, which are, in the order of their frequency, proliferated epithelium, lymph-exudations, and crystalline deposits.

When change in the epithelium is the cause of the granulations, a vertical section shows simply a proliferation of cells projecting into the ventricle, like villi.

When lymph-exudations have pushed the ependyma upwards, it presents the appearance of rough, irregular, bullæ-like nodules, consisting of the layer of proliferated epithelial cells, and a greenish homogeneous stroma, which together overlie the pia mater; the same material can be frequently seen infiltrating the subjacent cerebral tissues. Deposits of phosphate of lime have been recorded as occurring beneath the ependyma of the lateral ventricles in general paralysis, and Bergmann discovered a formation of pretty large crystals of 'double phosphate' in both plexus choroidei in a case of 'mania with mental weakness' (Griesinger, *New Syd. Soc. Trans.*, p. 429).

A proliferation of the columnar epithelium of the central canal of the medulla oblongata is not unfrequent, causing its occlusion.

The Nerve-cells.—The changes in the nerve-cells are most marked in the anterior two-thirds and superior parts of the hemispheres, as in this situation they are usually most numerous and large in size. In the depending portions of the hemispheres and the occipital lobe few, if any, changes have been noticed.

The special morbid conditions of the nerve-cells are:—α. Atrophy; or pigmentary, granular, or fuscous degeneration. β. Hypertrophy. γ. Calcification.

Pigmentary, fuscous, or granular degeneration is a very common condition in many forms of insanity, particularly senile insanity and general paralysis, and is probably to some extent a normal senile change. Dr. Major distinguishes three stages:—1st. The cells lose their sharply defined triangular contour, and become swollen or inflated in appearance; the process running towards the periphery of the convolution usually remains distinct, but the other processes disappear, and the cell becomes rounded off; the nucleus becomes swollen and more or less round or oval, and the nucleoli are seen with great distinctness. 2nd. A deposit of granules takes place, either external to the cell and pressing upon it, or in its interior, until it becomes more and more yellow and opaque; or both these conditions may occur together. 3rd. The cell goes on to destruction, breaking down and shrinking, leaving the nucleus surrounded only by a mass of granules, and forming a gap in the cerebral tissue formerly occupied by the swollen cell; still later the granules entirely disappear, leaving the nucleus free. He has not observed the nucleus actually undergoing disintegration, but often no trace of it is to be found in the mass of granules left by the degenerated cell.

Hypertrophy of the large pyramidal cells of the inner layers has been observed in senile atrophy and general paralysis; as the name implies, they are large, abnormally distinct and swollen in apperance, often presenting granular masses in their interior; the processes are increased both in size and number; and the angles of the cells may be greatly prolonged or swollen and stunted.

Calcification of the cells by the deposit of phosphate of lime within their walls has been observed, according to Blandford.

The Nerve-fibres.—The chief changes in nerve-fibres, apart from their disintegration by apoplexies, softenings, &c., are coarseness, irregularity and twisting of outline, and their power in the fresh state of resisting pressure under a covering glass, some becoming readily ampullated. They may be affected by a pigmentary degeneration similar to that occurring in the cells; and finally they may present fusiform or oval swellings, which tint strongly with carmine, and give rise to the appearances known as amyloid bodies.

Special Morbid Conditions of the Grey Matter.—In many subjects when the pia mater is thickened and hyperæmic, a condition of the grey matter closely resembling grey degeneration in the white matter is often found; it differs from the latter by the absence of proliferated nuclei, and is strongly suggestive of lymph-infiltration, which has gradually caused atrophy and absorption of the normal structures. Circumscribed spots of yellow softening show under the microscope ragged fibres, colloid bodies, and granular corpuscles at the base of the diseased tract.

Local atrophies of the convolutions are pretty common; under the microscope a thin layer of indurated grey matter, presenting no trace of normal structure, may be found; in other cases there is simple absence of the grey matter, the white matter in both being unaffected.

The Neuroglia.—This substance undergoes inflammatory changes of a sub-acute or chronic nature, with the results of which we are familiar as more or less diffused *sclerosis*. Together with the other elements of the cerebral tissues, it undergoes atrophy in the brain-wasting of senility, and especially of senile dementia; it is also liable to special forms of degeneration, which have been called miliary sclerosis and colloid degeneration, though those terms are somewhat misleading, as the changes in question differ entirely from those generally described by these names.

General sclerosis has only been observed in one case, which is fully detailed in the *Journal of Anatomy and Physiology*, May, 1873. In a hydrocephalic epileptic idiot (whose brain weighed sixty ounces) the hemispheres varied in weight; the left being 23½ ounces, the right 30¼ ounces. In the heavier or hypertrophied side, the nerve-fibres were found lying in fasciculi consisting of from four to six strands; these fasciculi were separated from one another by a clear, finely-fibrillar plasm in which nuclei existed, somewhat larger than normal.

Disseminated or *partial sclerosis*, or *grey degeneration*, is a lesion frequently met with in the brains of old-standing cases of insanity, especially in general paralysis. Its most frequent seat is the white matter of the motor tract; less frequently it is met with in the hemispheres. In the pons varolii, medulla oblongata, and spinal cord of epileptics patches of this disease are of common occurrence and in an extreme degree. When a fine section of nerve-tissue affected by this disease is examined by the naked eye, circumscribed opaque patches can be seen; in coloured sections these tracts are strongly tinted; as a rule, they are found contiguous to a vessel whose nuclei are much proliferated, and around which considerable proliferation of the nuclei of the neuroglia exists. Under the microscope, the nerve-fibres are seen to be partially or completely atrophied; the axis-cylinders and sheaths are destroyed; and the field is occupied by a finely molecular and fibrillated material, imbedded in a cloudy homogeneous plasm. In this matrix the proliferated nuclei exist, somewhat enlarged, sometimes slightly granular in appearance; but around the implicated spot they are to be seen in much greater quantity, and not actively diseased. The atrophied nerve-fibres occasionally project raggedly into the grey matter, where they are lost. Rokitansky believes this to be essentially a primary increase of the neuroglia. Leyden thinks it occurs secondarily to the atrophy of nerve-fibres; while Rindfleisch and others are of opinion that the first stage is marked by proliferation of the nuclei of the vessels, which is followed by an increase of the neuroglia, and the development of a morbid plasm, which is, in all probability, modified neuroglia.

Miliary sclerosis.—For the full details of this remarkable lesion the reader is referred to the *Edinburgh Medical Journal* for September, 1868, and to the *British and Foreign Medico-Chirurgical Review*, July, 1873. The following is a short account of its principal features. It is not confined to any one class of mental disease, but has been found best marked in cases accompanied by paralysis or epilepsy. It differs from all other lesions termed sclerosis in not being preceded, attended, or followed by proliferation of the nuclei; it is a circumscribed lesion, occurring in patches from $\frac{1}{40}$ to $\frac{1}{500}$ of an inch in length, not involving surrounding tissues, except by displacement, diffusing no morbid plasm beyond its own area, and not connected with the blood-vessels. It is essentially a disease of the nuclei of the neuroglia, and its progress is marked by three stages:—1st. A nucleus becomes enlarged, and throws out a homogeneous plasm, of a milky colour and apparently of a highly viscid consistence, forming a semi-opaque oval spot, usually unilocular; but by aggregation the spots may be bilocular, or, more rarely, multilocular. In the centre of these spots a cell-like body containing a nucleus is discernible—the original dilated nucleus of the neuroglia. 2nd. The morbid plasm becomes distinctly molecular, and permeated by fine fibrils; as it advances, the plasm round the periphery of the spot becomes more dense, and a degree of absorption of the nerve-fibres around it takes place. 3rd. The molecular matter contracts on itself, becomes more opaque, and often falls out of the section, leaving ragged holes.

Colloid degeneration may be either a primary or a secondary product, that is to say, there is reason for believing that in certain forms of insanity it is the primary pathological change, and that it is also to be met with in the brains of chronic cases as a result of long-continued perverted vascular action. It has been produced artificially in the brains of pigeons by incising them and allowing the wound to heal. This degeneration should be searched for in recent specimens. It consists of round or oval bodies, from $\frac{1}{4000}$ to $\frac{1}{2000}$ of an inch in diameter, bounded by a distinct wall containing a homogeneous, transparent, and colourless plasm; sometimes it is somewhat granular. The general appearance of a section may be compared to a slice of cold sago-pudding; it cannot be coloured by carmine. The condition may be regarded as a degeneration of the nuclei of the neuroglia, and is found in both grey and white matter.

The Blood-vessels.—When we examine an injected preparation of the substance of a cerebral convolution, and witness the perfection and

delicacy of its circulatory apparatus; and when we reflect on the results of the phenomena of congestion, stasis, and anæmia on the functions of other organs; we have little difficulty in comprehending the influence such conditions must have upon the highly complex elements which make up the organ of the mind. It is certain that in most cases of recent insanity, disturbance of the cerebral circulation is one, if not the essential, pathological factor; and if such disturbance is of long continuance, permanent lesions of cells, fibres, and nuclei, and, as a consequence, chronic insanity in some form, must result. The examination therefore of the cerebral vessels is of primary importance.

The following is the method of examination adopted by the writers:—After noting the degree of engorgement or anæmia in the centrum ovale, and whether on section the vessels are dragged out by the knife, vessels of moderate size should be dissected out and carefully washed with camel's-hair brushes, and then submitted to the microscope. By this mode of procedure the following changes may be discovered:—(*a*) Thickening or degeneration of one or other of the coats. (*b*) Thickening of the sheath or hyaline membrane. (*c*) Deposits between the adventitia and the sheath. (*d*) Proliferation of the nuclei.

(*a*) *Thickening or degeneration of the coats.*—The *inner fibrous* coat has been found thickened and more fibrous than in health. The *muscular coat* is often hypertrophied, especially the circular fibres; it is best marked in general paralysis and epilepsy. The *adventitia* is occasionally thickened. The whole of the coats sometimes undergo a hyaloid or vitreous change, which is probably allied to lardaceous disease.

(*b*) The *hyaline membrane* or *sheath* is often thickened and fibroid, enveloping the artery in a loosely sacculated manner.

(*c*) *Deposits* between the adventitia and the sheath are of two kinds; but neither is peculiar to insanity, being found in the brains of persons who have died of fever or Bright's disease with cerebral symptoms. The first is a finely molecular material of a pale yellow tint, or more often colourless, closely resembling in appearance the spores of the Favus fungus, and refracting light highly; it undergoes no change when treated with the ordinary oil-tests, and is found on the smallest capillaries. The particles vary in size from $\frac{1}{4000}$ to $\frac{1}{7000}$ of an inch. The second form of deposit consists of irregular crystals of hæmatoidin distributed pretty equally over the vessels, except at the bifurcations, where they are aggregated.

(*d*) *Proliferation* of the *nuclei* usually accompanies proliferation of the nuclei of the neuroglia; they do not seem to increase to the same size as those of the neuroglia, but become oval or irregular in shape.

Fine sections of hardened tissues are necessary for the demonstration of the following vascular changes:—(*e*) Abnormalities in direction. (*f*) Dilatation, microscopic aneurisms, and apoplexies. (*g*) Perivascular spaces. (*h*) Syphiloma.

(*e*) *Abnormalities in direction* may take the form of extreme tortuosity or actual thickening; these are usually evidences of congestion, but may under certain circumstances be produced artificially.

(*f*) *Dilatation, microscopic aneurisms, and apoplexies.*—Ecker, Romaer, and Major have found a general dilatation of the small vessels in mania and 'brain-wasting.' MM. Bouchard and Charcot have carefully described the appearances of microscopic aneurisms; they are usually fusiform, more rarely sacculated, measuring $\frac{1}{30}$ to $\frac{1}{40}$ of an inch in length, their breadth being one-fourth of their length. These authors describe a thickening of the fibrous coats, with proliferation of the nuclei, and atrophy of the transverse muscular striæ. Drs. Bastian and Blandford have described a thrombosis of the minute vessels by masses of white corpuscles occurring in mania and delirium.

(*g*) *Perivascular spaces.*—In subjects who have been liable to cerebral congestion the vascular canals are often distinctly dilated, to an extent several times the calibre of the vessels; the brain substance bounding them is condensed.

(*h*) *Syphiloma* of the cerebral arterioles is characterised by the formation of a plastic deposit around their walls, which becomes converted into fibrous tissue, and gives to their transverse sections an enormously hypertrophied and concentric appearance, going on to almost complete occlusion of the canals.

Tumours.—Tumours have been met with in some cases of insanity, but as no growth peculiar to insanity has been described, it is unnecessary to enter into their description.

The Spinal Cord.—Microscopic examination of the spinal cord has not revealed any lesion peculiar to the various forms of insanity, excepting general paralysis. Drs. Westphal, Meredith Clymer, Boyd, and others are of opinion that in this disease well-marked departures from health are to be found. The first-named pathologist describes an atrophied condition of the cells of the posterior columns, with increase of their connective tissue, commencing externally and extending inwards; he also believes in a chronic myelitis affecting the posterior columns and the posterior sections of the lateral columns. As far as the writers have been able to observe, this is by no means an invariable accompaniment of this disease, although in one case it was undoubtedly present. The cells of the cord were in most instances undergoing fuscous granular degeneration, like those of the hemispheres.

The Sympathetic System.—The sympathetic ganglia undergo a pigmentary degeneration in various forms of cerebral disease.

J. Batty Tuke.
Robert Saundby.

INSANITY, Varieties of.—In this article various forms of insanity will be described under separate heads. Dementia, General Paralysis of the Insane, Mania, and Melancholia will be found in other parts of the work.

1. **Alcoholic Insanity.**—The conditions included under this head must not be confounded with what is called dipsomania. In the latter affection the indulgence in alcohol is a symptom, and not necessarily a cause; while here the insanity is always a direct result of some form of alcoholic poisoning. It is met with in three forms, namely, *acute alcoholic insanity*, *chronic alcoholic insanity*, and *delirium tremens*.

Acute alcoholic insanity seldom occurs except when there is a strong heriditary tendency to mental disturbance, or when the cerebral energies have been notably impaired by excesses or overwork. Where all these predisposing causes exist, it may not require a large dose of alcohol to bring on an attack. The most frequent form of the affection is violent maniacal delirium, known as *mania a potu*, with a tendency to homicidal acts. In some cases the mental disorder takes the melancholic form, and it becomes necessary to guard specially against the strong suicidal tendency which generally characterises it. Unless the brain has been weakened by repeated attacks, both forms are curable and generally of short duration. The treatment is the nourishing, non-stimulating regimen detailed in the articles on Mania and Melancholia.

Chronic alcoholic insanity is one of the results of chronic alcoholism, and there is no condition which better illustrates the 'solidarity of the psychical and somatic functions of the nervous system' and the interdependence of their morbid manifestations. The physical symptoms are fully described in the article on Alcoholism; the mental symptoms are generally present from the beginning, though not always prominent enough to attract special attention. The sleeplessness, so characteristic of commencing mental disorder, is an early symptom; then restlessness and depression, with suicidal tendency, sometimes passing rapidly into complete dementia, but generally passing gradually through a course of moral and mental degradation, which progresses step by step with the symptoms of failure of physical nervous power. The affection presents many points of resemblance to general paralysis of the insane, and is in some cases only to be distinguished from it by obtaining evidence of alcoholic poisoning, and by the persistence of the mental depression, which is seldom more than a transitory symptom in the general paralytic.

Delirium tremens is described fully under the heading of Alcoholism; but it is proper to note here that after the acute symptoms of that disease have passed away, there is sometimes left behind a state of subacute insanity of a characteristic nature. At first suicidal symptoms are apt to appear. Suspicions of poisoning, fear of impending evil, and hallucinations of hearing are also frequent. The treatment required is constant companionship of a trustworthy attendant, exercise, fresh air, and change of scene, with attention to every ordinary means of restoring the functions to a healthy state. Under proper treatment the prognosis is favourable.

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2. **Amenorrhœal Insanity.** — Mental derangement is often accompanied in females by suppression of the menses. But in many such cases the insanity cannot be called amenorrhœal, as the cerebral and uterine disorders may only be associated as both symptomatic of some debilitating cause affecting the whole system. Then the mental condition is usually the depression produced by anæmia. But there is a mental derangement directly resulting from sudden suppression of the catamenia, to which this distinctive name is not inaptly applied. Here the insanity takes the maniacal form. It is sometimes ushered in with urgent febrile symptoms, in which case the mania assumes the acutely delirious character. Where general febrile disturbance is not prominent, the mental condition is more simply maniacal, and sometimes does not get beyond mere irritability with delusions. The pathological condition must in either case be regarded as mainly a hyperæmia of the brain.

Treatment.—This must be directed towards the restoration of the arrested discharge. If the patient be seen at the commencement of the attack, the hip-bath and a gentle purgative may recall it. If the menstrual period has passed, the attention of the practitioner must be devoted to the relief of the more urgent symptoms. If the symptoms of cerebral congestion are distinct, leeches will probably be found useful. Regular action of the bowels should be secured, but active purgation should be avoided. The food ought to be easy of digestion, and care should be taken not to let it be deficient in quantity. If the mental excitement is great and long-continued, it will necessarily produce considerable exhaustion, and the condition of the patient after recovery from the mental excitement will depend very much on the extent to which the strength has been supported during the continuance of this strain. The re-appearance of the catamenia generally implies recovery of mental health; but cases occur where prolonged amenorrhœa leads to a chronic maniacal condition, ultimately passing into hopeless dementia.

John Sibbald.

3. **Choreic Insanity.**—There appears to be an intimate connection between the pathological basis of chorea and a certain disturbance of the mental functions. The physical and the mental symptoms however do not necessarily correspond in intensity. Sometimes where the convulsive symptoms are very severe, the mental condition is merely one of dulness, apathy, or irritability. In children it shows itself generally in a maniacal restlessness, accompanied by delirium of a peculiarly automatic character. It is frequently associated at all periods of life with the rheumatic condition, and hence it has by some authors been called rheumatic insanity. It generally commences with sleeplessness and delirious excitement of a remittent character, which is sometimes accompanied by violent convulsive effort. As the excitement passes off, delusions of suspicion are apt to arise, and these are strangely associated with an apathetic mental condition. In the acute form the prognosis is favourable, recovery generally taking place in from four to eight weeks. The chronic form is apt to pass into dementia.

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4. **Epileptic Insanity.** *See* Epileptic Insanity.

5. **Feigned Insanity.** — Insanity may be feigned in order to escape the obligation of duty, or the consequences of crime. If manifested at a time when its recognition might be a benefit to the individual, it becomes necessary to test its reality. It must not be rashly inferred in any case that insanity is feigned; for it sometimes results from the excitement consequent on a sense of guilt or

the shock of a false accusation; or it may arise coincidently but independently of such conditions. The best preparation for making a satisfactory examination in such a case is a familiar acquaintance with the appearance and conduct of persons undoubtedly insane. A person feigning insanity must, to be successful, simulate some known form of the disease; and as each form presents a more or less definite group of symptoms, an impostor is apt to reveal the truth by omissions or by additions inconsistent with the part that he attempts to play; but the mistake generally made by the impostor is to over-act the part. The inquiry may, of course, assume various aspects. A person may pretend to have been insane *at the time* a certain act was committed. Here it is to be remembered that the insanity, if real, would not probably have been confined to the time of the commission of the crime; and some evidence of premonitory symptoms previous to the act would probably be found. In such cases it is proper to regard want of motive as so far an indication of insanity; but when the supposition of a sudden mental perturbation is put forward, some reason would have to be shown for its occurrence; and some history of the occurrence of cerebral injury, or of previous attacks of insanity, epilepsy, or other cerebral affection ought to be forthcoming. A person feigning to be insane *at the time he is examined* must endeavour to present symptoms of either mania, melancholia, monomania, dementia, or imbecility. When the symptoms arise suddenly, simulation of the maniacal condition is generally attempted. The exertion which this entails will, however, generally compel an impostor to exhibit symptoms of fatigue, and even to sleep, when the true maniac would exhibit persistent excitement. The raving also when feigned may be recognised as hesitating and premeditated. Forgetfulness, which is generally assumed by the impostor, is an unfrequent symptom of mania, except when it occurs in the course of general paralysis, and this is a disease whose other symptoms could scarcely be simulated. If melancholia or monomania be feigned, the chief facts to be borne in mind are that such conditions, when real, are very unlikely to arise suddenly where there are no symptoms of bodily disease to account for them; and that they are usually characterised by a tendency to conceal peculiarities, or at least not to push them ostentatiously forward. Dementia never occurs suddenly without evident cause. A class of cases occur in which insanity is only partially feigned. Young criminals frequently try to exaggerate the signs of the intellectual weakness which is so generally mingled with their moral depravity, in hopes of obtaining a relaxation of discipline, or a transference from a prison to an asylum. Such cases are often full of difficulty. The principle which ought to regulate our action is to avoid the continuance of punishment when disease or deficiency renders it useless. Before deciding upon the reality of any doubtful case of insanity, all the physical conditions of the individual, such as the amount of sleep, the state of the pulse, skin, tongue, and digestive system generally, the conduct and the state of health immediately preceding the signs of insanity, should be ascertained. The effect of remarks made within hearing of the suspected person should be observed; one who proclaims his own insanity should be distrusted. And the medical history of the family and of the individual should be inquired into, with a view to disclose anything which might have caused insanity or predisposed to it.

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6. **Gastro-Enteric Insanity.** — The emotional condition is well known to be to an appreciable extent dependent on the state of the *primæ viæ*; and where the nervous system is predisposed to derangement, certain affections of the stomach and bowels seem sufficient to produce insanity, and to stamp it with a special melancholic character. In addition to the mere depression caused by anæmia, there is associated with such affections a peculiar anguish of mind, and tendency to self-accusation, which is often of the most distressing nature. Refusal of food is frequently a prominent symptom. The intellectual perversion is often slight, and seldom so prominent as in other acute insanities. Relief of the bodily symptoms is generally accompanied by a return to sanity. The affections which have been most frequently observed to produce this form of melancholia, are irritation and catarrh of the mucous membrane, constipation, stricture or other causes of distension of the viscera, and pressure upon the stomach or intestines by tumours in the epigastric region. Schroeder van der Kolk described the mental symptoms as being always due to affections of the colon; but disease of other portions of the canal—as the rectum and anus—seems also to produce them.

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7. **Hereditary Insanity.**—SYNON.: Fr. *Folie héréditaire*; Ger. *Erbliche Geisteskrankheit.*—This implies insanity symptomatic of hereditary weakness of the nervous system, generally coming on without the intervention of appreciable exciting cause.

The nervous system seems to be peculiarly liable to be involved in the effects of hereditary degeneracy, and this is frequently evinced by the occurrence of mental symptoms. The ages at which these are developed, and the character which they exhibit, depend both on the nature and on the strength of the hereditary disposition. The forms of insanity, however, which seem to be most directly the result of hereditary influence, generally make their appearance at those periods of life when either rapid structural development takes place, special functional activity is first exhibited or is ultimately arrested, or upon the advent of senile decay. The ordinary exciting causes of insanity may also affect persons at these periods, and in such cases the resulting disorder will be stamped more or less distinctly with the impress of its origin. But where these forces do not come powerfully into play, it is found that hereditary insanity exhibits a special character according to the period at which it is developed. We have thus an *insanity of pubescence*, a *climacteric insanity*, and a *senile insanity*. Idiocy and imbecility (which will be found discussed under their respective heads) are also frequent results of hereditary weakness, showing itself during fœtal life, or during the period of dentition; and the

mental derangements which often affect women at parturition, and during the processes which precede or follow it, seem to occupy a position in the pathological scale intermediate between the hereditary and the accidental form of insanity.

Insanity of pubescence is a condition not unfrequently met with, and one which it is very important to recognise early in its true character. Much unintentional injury is frequently done by the patient being at first regarded as a delinquent and treated accordingly, instead of receiving the careful management suitable to the disease. The affection is characterised by great disorder of the emotional and moral nature, which is evinced by restless though seldom violent excitement, eroticism, acts of purposeless mischief, and exhibitions of inordinate vanity. Any marked change of disposition during the passage from youth to adult life ought to be regarded as probably pathological in its nature, and must be carefully watched. Persistent sleeplessness at such a time must also be regarded as significant of danger to the mental functions. The physical condition is indicated by capricious appetite, and symptoms of anæmia. The treatment required is rest to the mind, both in its intellectual and emotional energies, with cultivation of everything likely to develop physical vigour. If the hereditary tendency is not exceptionally strong, or aggravated by accidental causes, the prognosis is not unfavourable.

Climacteric insanity occurs in males between the ages of fifty and sixty, and in females between forty and fifty. Its general character is a form of melancholia, gradual in its development, manifesting itself in loss of sleep, fear of undefined evil, religious despondency, hallucinations of the senses, refusal of food, and frequently in a suicidal tendency. Excitement and exaltation occur rarely, and are generally of short duration. The mental disorder is frequently accompanied by very marked emaciation, and the tendency is always to anæmia. The treatment required at the commencement is cessation of mental labour and change of scene. During the whole progress of the disease the diet should be full and nourishing, and the digestive functions often require to be stimulated to healthy action. In the majority of cases the prognosis is unfavourable, and where recovery does not take place within one or at most two years the course is generally towards dementia.

Senile insanity is essentially a form of dementia, which comes on gradually in persons who have passed through the earlier periods of life without disturbance of their mental health, but who break down in old age. Its principal features are loss of memory, slight excitements, whimsical likings and dislikings, querulousness, and a gradual decadence into fatuity. It is subject to occasional remissions, which are sometimes very short, as when caused by the stimulus of acute febrile conditions. But they are sometimes so prolonged as to amount practically to recovery. Not infrequently the breakdown of the nervous system pursues a rapid course, and in such cases there is often a marked similarity in the symptoms to those of general paralysis. Both mental and physical conditions in the advanced stages of each are sometimes practically indistinguishable. The diagnosis will depend on whether the characteristic first stage of general paralysis has been observed at the commencement, or only a gradual loss of physical and mental power. Paralytics, moreover, are seldom of advanced age.

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8. **Impulsive Insanity.**—Violent acts are committed under an insane impulse by numerous patients whose insanity is plain and acknowledged. They may be done under the influence of delusions or hallucinations, but the term *impulsive insanity* is commonly applied to a disorder manifested, not by delusions and similar symptoms, but by acts of violence to which a patient is driven by blind, uncontrollable, and morbid impulse, whereby the will and the reason are overpowered for a longer or shorter time. These are for the most part acts of *suicide* or *homicide*; and in connection with the latter, great controversy has arisen as to the responsibility of persons committing them. Here, as in moral insanity, there are no delusions; frequently no change will have been detected in the individual prior to the act, nor will there be observers of it. And it is a fact that the impulse may be satisfied and exploded in the act, and having thus found a vent may be felt no longer, at any rate for a time. It may be as sudden as an epileptic fit, and may, like the latter, bring relief to the brain. Indeed, there is a strong connection as well as analogy between the two disorders, and, as Dr. Maudsley says, instead of a convulsive movement there is a convulsive idea.

In estimating such acts as these we must not only consider the act itself and the manner of its performance, but must also closely inquire into the past history of the perpetrator and his progenitors. For all this we may or may not have opportunity. If the act is one of attempted suicide, and the individual is kept under observation, we may have no difficulty in diagnosing insanity. If it is one of homicide, and the criminal is in prison for, perhaps, only a week or two, opportunity of ascertaining the history of his family may fail, nor will he himself be under skilled observation. Moreover the period just after the committal of an impulsive homicide will very probably be the one in which fewest symptoms of insanity will be noticeable. The period immediately preceding it will be that which most closely demands a scrutiny, but we may be able to get no information if the accused has been moving from place to place, has been among strangers, or has had those about him who were obtuse and unobservant. Many an act of suicide and homicide would be prevented if the friends would not shut their eyes with such pertinacity to the strange and altered looks and conduct of the patient. But in this impulsive form, although there may not have been enough to warn those about a man to restrain him, there may have been symptoms which are sufficient subsequently to indicate to a physician the presence of mental disorder. There may have been attacks of *grand mal* or *petit mal*: there may have been former attacks of insanity, periods of, it may be, slight depression, which, though they may have attracted little notice at the time,

may indicate an insane diathesis. The sufferer may have been sleeping badly or have taken less nourishment than usual.

The medical witness will, in the case of homicide, carefully examine and pay special attention to the following points :—

(*a*) The nature and character of the act must be noted. The presence or absence of motive may often assist us. When the victim is near of kin and dearly loved, suspicion of insanity will at once arise. When, on the other hand, it is a perfect stranger, never before seen, where there has been no previous meeting or quarrel, the same suspicion will arise. The method of the act may guide us somewhat, but not so much. There may be premeditation, though generally there is not.

(*b*) The demeanour of the prisoner after the act may assist us. Were there, or were there not, attempts to conceal it, or to escape detection and arrest? What was said in explanation? It sometimes happens that there is complete unconsciousness or forgetfulness of what has occurred, and we may then strongly suspect the presence of epilepsy.

(*c*) We must closely inquire into the family history, and shall often find that in cases of impulsive homicide, the family of the accused is saturated with insanity. And where this is so, we may also find that from youth the accused has been deficient and weak in intellect, or odd and eccentric. The weak-minded, in fact, may be grouped in a special class of homicides. As there is a weak-minded moral insanity, so there is a weak-minded impulsive homicidal insanity the sufferers from which have not unfrequently been hanged, their insanity not having been sufficiently marked to absolve them from legal responsibility. Fits in childhood may contribute to this state. And throughout, at the age of puberty, or in adult life, there may be slight but sure indications of the insane blood that has been inherited, which are displayed in an impulse to homicide or suicide, even as in others the tendency is shown in ordinary attacks of insanity.

(*d*) We must look very closely for symptoms or a history of epilepsy. Such indications as nocturnal micturition or a bitten tongue may guide us to the truth, while in acknowledged epileptics it may happen that the homicidal attack takes the place of the ordinary convulsion, and without the occurrence of the latter there may be a period of unconsciousness and unconscious action lasting, perhaps, for days. *See* Epileptic Insanity.

The occurrence of one homicidal attack of a strange or anomalous character may make us fear its recurrence, and when we have to examine a criminal who has committed one act of this kind, it is important to inquire whether he has ever at any former time done any sudden act of violence of a similar description. For this reason such patients should not be released from an asylum, except under great and special precautions.

G. F. Blandford.

9. Legal Insanity.—Lawyers regard insanity from a different point of view from medical men. A medical man applies his mind to its study so as to ascertain how far he may infer from the evidences of mental action the existence of morbid conditions which he may hope to alleviate or remove. It is therefore his duty to be acquainted with such symptoms as give the earliest indication of the approach or development of these morbid processes. For it is during their initiatory stages that he may most successfully intervene with the resources of his art, to check their progress or to ward them off. He therefore identifies with the existence of disease, every deviation from the healthy mental standard which indicates the necessity for medical treatment or advice. A lawyer, on the other hand, takes note of insanity only in so far as it affects the safety of person or the preservation of property. The question which he seeks to determine is whether a person is justly responsible for certain acts which he has committed, or is competent to perform certain acts which he may be called on to perform. It is evident, therefore, that the legal view of insanity must naturally be much more limited than the medical. 'A lawyer, when speaking of insanity,' says Mr. Justice Stephen, 'means conduct of a certain character; a physician means a certain disease one of the effects of which is to produce such conduct;' and though this has been adversely criticised it seems to show correctly the directions in which the two views diverge. They might perhaps be as fairly indicated in other words if we say that the lawyer has to deal with the nature or quality of certain acts, while the physician has to deal with the condition of certain persons. No satisfactory general definition of legal insanity has been given. In the earlier ages of our legal system none but the most outrageous cases of insanity were recognised. Bracton in the thirteenth century defined a madman as 'one who does not understand what he is doing, and, wanting mind and reason, differs little from brutes.' Sir Edward Coke, though he recognises different classes, according as the insanity is congenital, permanent, or temporary, only admits that a person is insane when he is *non compos mentis*, or has wholly lost his memory and understanding. Sir Matthew Hale, in the seventeenth century, was the first to recognise the existence of less extreme forms of insanity. 'Some persons,' he said, 'that have a competent use of reason in respect of some subjects, are yet under a *particular dementia* in respect of some particular discourses, subjects, or applications; or else it is partial in respect of degrees, and does not excuse persons who commit capital acts in this state.' He also said that it is 'very difficult to define the invisible line that divides perfect and partial insanity,' and 'that most persons that are felons, of themselves or others, are under a degree of partial insanity when they commit these offences.' The recognition of these gradations, reaching even to the mutual overlapping of crime and insanity, indicates as much breadth of view as could be expected at a time when the very judge who recognises them passed sentence of death on persons convicted of witchcraft. We cannot doubt, indeed, that at that period the ignorance of the nature of insanity was such that many lunatics were executed for this offence. The recognition of the necessity of taking legal account of minor degrees of insanity

than 'furious madness' or idiocy may be said to commence at the beginning of the present century. The mode in which unsoundness of mind comes intc relation with law at present, may be looked at most conveniently from three points of view:—1. Where a person suffers from such unsoundness of mind that it is necessary for his welfare, or the safety of the public, that his liberty should be restricted by his being placed in an asylum or subjected to similar restraint. 2. Where a person suffers from such unsoundness of mind that he is incapable of managing himself or his affairs. 3. Where irresponsibility for crime, on account of insanity, is pleaded in a court of law. It will be found more convenient to consider these three relations of insanity and jurisprudence separately. The reader is consequently referred to the articles specially devoted to them, which will be found under the heads of LUNACY, Law of; CIVIL INCAPACITY; and CRIMINAL IRRESPONSIBILITY.

JOHN SIBBALD.

10. **Moral Insanity.** — SYNON.: Fr. *Manie sans délire*; *Folie raisonnante*; *Monomanie affective*; Ger. *Gemüthswahnsinn*.

Under the names of *moral insanity, emotional insanity, impulsive insanity, affective insanity*, has been described the disorder of certain patients, which is manifested by insane actions and conduct rather than by insane ideas, delusions, or hallucinations. Such persons are sometimes said to be of whole and perfect intellect, though unsound in the moral and emotional part of their brain. They come under the notice of medical men, not so much for purposes of treatment as for diagnosis. Their conduct being chiefly displayed in foolish or violent acts, they require to be restrained, and the question arises: Is this conduct badness or madness? are they responsible for it or not?

Dr. Maudsley gives *moral insanity* and *impulsive insanity* as two subdivisions of *emotional* or *affective insanity*; and, as the symptoms are certainly different, we cannot do better than consider them under separate heads. But certain observations are applicable to both. In neither will there be found delusions, and as delusions are, in the opinion of some, especially lawyers, necessary to the establishment of legal insanity and irresponsibility, these patients are not legally insane. Another remark is that this moral or impulsive insanity does not constitute a definite and well-marked disease, like acute delirium or general paralysis. Every patient may at one time or other be 'morally insane,' that is, may not have reached the stage of delusions, or may have recovered from it, and every patient may commit 'impulsive' acts of violence, whether his insanity is displayed in other ways or not.

By *moral insanity* is to be understood a disorder of mind shown by an entire change of character and habits, by extraordinary acts and conduct, extravagance or parsimony, false assertions and false views concerning those nearest and dearest, but without absolute delusion. Such a change may be noticed after any of the ordinary causes of insanity. It may follow epileptic or apoplectic seizures, or may be seen after a period of drinking. Its approach is gradual, as a rule, rather than sudden, and the extraordinary character of the acts may not at first be so marked as subsequently. Friends wonder that a man should say this or that, or should do things so foreign to his nature and habits, but some time may elapse before they can convince themselves that such conduct is the result of disease, and the acts may be such that many will look upon them even to the last as signs merely of depravity. Such insanity of course varies in degree. When it is well marked, and the conduct is outrageous, there will be no difficulty in the diagnosis. But it may be less marked; it may consist of false and malevolent assertions concerning people, even the nearest, of little plots and traps to annoy others, in which great ingenuity and cunning may be displayed. And there will be the greatest plausibility in the story by which all such acts and all other acts will be explained away and excused. It would seem sometimes as if a universal badness had taken possession of the individual, yet a badness so inexplicable that it can only be looked upon as madness. Where we can ascertain that this condition of things is something which has come over the patient, being formerly absent, and that he is altogether changed, we may suspect insanity. But much examination and opportunity for examination may be needful before we can sign a certificate, for such people are often very acute, and quite on the alert. They have no scruples about falsehood, and will deny or justify everything with which they are taxed; and where the insanity is manifested in conduct, the medical man may never be a witness of it, and is obliged to receive on hearsay that which the patient strenuously denies. Careful inquiry, however, will probably reveal the origin and cause of the change; there may have been a period, though short, of acute insanity—as acute mania or melancholia—which passed away and left this as a permanent condition; or it may be the precursor of a more advanced stage of the disorder, one marked by the ordinary symptoms, as delusions and hallucinations. If the change has been rapid and progressive, if the sufferer has become more and more outrageous and eccentric, it is likely that in a short time unmistakable insanity will be displayed; but some cases progress slowly, and steps for restraint have to be taken before anything like delusion is to be found. It may be necessary to prevent a man from squandering all his property —a common symptom in this variety—or from wandering from home and absenting himself no one knows where, or keeping low company. And when a man previously quite sober suddenly takes to drinking, the question may arise whether this is not the effect of insanity. Great difficulty may be found in proving the latter, but unquestionably it is often the case. Here, however, if the habit is indulged in, the patient will most likely get rapidly worse, and then restraint will be more easily enforced.

Moral insanity may be the precursor of general paralysis; it may also be the sequel and result of a more severe insanity; it may be the outcome of apoplexy, or of a blow or other damage to the brain. It may be one of the alternating states of the so-called *Folie circulaire*. Here a period

of depression alternates with one of excitement, gaiety, self-glorification, or irascibility, and the latter may be one closely resembling that usually called moral insanity, and evidenced by exaggerated conduct and absurd acts. It may follow a simple attack of epilepsy, or may be the precursor of such attacks, being a part of that epileptic condition known as masked epilepsy. *See* Epileptic Insanity.

The one constant and marked feature of this insanity is the absence of delusion; but we are not on this account to argue that the intellect is sound. There is often great acuteness and cunning displayed by such patients, yet along with the cunning there may be the most silly and foolish conduct. Often there is great acuteness shown by those who have delusions, but because of the latter we say their intellect is disordered. Yet it is proof of disorder of the intellect if a patient spends his capital as though it were income, defends and justifies the most outrageous acts, and cannot be made to see that they are outrageous. Close examination will probably reveal the fact that there is very considerable intellectual lesion in these cases. There is a want of the power of attention and concentration of ideas on a subject. A patient commences a story of his grievances, and in two minutes is far away from his theme, and is boasting of his virtues or conduct, and no amount of bringing back will enable him to give a definite and succinct account of what he has to complain of. Such rambling is a marked symptom of this insanity, and a strong indication of a weakened intellect.

There is one more form of moral insanity which is, perhaps, the hardest of all to diagnose and estimate. It is the congenital moral defect occasionally met with in persons who have been from birth odd and peculiar, and incapable of acting and behaving like other people. They can hardly be called idiots or imbeciles, for they may exhibit a considerable amount of intellect and even genius in certain special directions. We shall generally find that they are the offspring of parents strongly tainted with insanity, epilepsy, or alcoholism, and many in childhood are the subject of fits, chorea, or other neuroses. They are incapable of being instructed like other boys and girls, are often frightfully cruel towards animals or their brothers and sisters, and seem utterly incapable of telling the truth or understanding why they should do so. Here there is no change; we cannot compare the individual's condition with a former one, but we can only estimate him by the average of mankind. These are the persons who commit crimes and become the chronic inmates of prisons, and it is most difficult both for medical and other prison-officials to say how far they are responsible, and how far not. Careful and special education is needful for them, and this they may obtain if they are born of well-to-do parents, but a vast number are to be found amongst the ranks of the lower classes; the offspring of intemperance and poverty, they swell the numbers of the criminal classes in no inconsiderable degree.

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11. **Pellagrous Insanity.**—This is a form of insanity associated with pellagra, and not met with in Britain. It is characterised by mental symptoms usually indicative of anæmia—great depression, frequently with tendency to suicide, passing on to chronic dementia. It is most frequently met with in Italy.

12. **Phthisical Insanity.**—It has been generally observed that there is a special mental character associated with pulmonary tuberculosis. This consists frequently in a peculiar cheerful hopefulness, which has received the name of *spes phthisica*, and which seems strangely out of harmony with the unmistakable signs of an inevitable doom by which it is accompanied. But there is also a state of mental depression which has been observed in intimate association with the disease. The peculiar hopefulness is most frequently met with in the acute and active forms of phthisis, and it is often so irrational and persistent as to amount to an insane delusion, growing as it does in strength while the evidences of its baselessness accumulate. In the last stages of the malady the religious and general emotional exaltation is often extreme, and actual delirium is not infrequent. An opposite mental condition is met with in chronic phthisis, more especially in that form of it which has been called latent. All through the course of the disease there is a prevailing depression and distrustfulness, though the physical symptoms are neither so distressing nor so obvious as in the acuter forms. The mental symptoms sometimes precede the physical. Languor and depression, mingled with waywardness, are characteristic of the initial stage. This is usually accompanied by general functional debility, which is often attributed to mere disturbance of digestion and nutrition. The skin is habitually pale, and the circulation feeble. In many cases the physical signs of pulmonary disease when present are apt to be overlooked, and occasionally they escape observation for years. Where the mind is much affected the ordinary symptomatic cough, expectoration, and dyspnœa are often absent; and this is the case sometimes where physical exploration reveals the existence of extensive vomicæ and other characteristics of advanced disease. The mental condition as the further stages are reached becomes less one of depression and more one of distinct enfeeblement. Occasional fits of considerable irritability and excitement occur. Dr. Clouston, who first drew special attention to this condition, says of the patients that 'there is a want of fixity in their mental condition. There is a disinclination to enter into any kind of amusement or continuous work; and if this is overcome there is no interest manifested in the employment. It might be called a mixture of subacute mania and dementia, being sometimes the one and sometimes the other. As the case advances, the symptoms of dementia come to predominate; but it is seldom of that kind in which the mental faculties are entirely obscured, with no gleam of intelligence or any tendency to excitement. If there is any tendency to periodicity in the symptoms at all, the remissions are not so regular, nor so complete, nor so long as in ordinary periodical insanity. If there is depression it is accompanied with irritability and the want of

any fixed depressing idea or delusion. If there is any single tendency that characterises these cases, it is to be suspicious.' Where any chronic form of insanity is associated with phthisis the chance of complete restoration to sanity is very small. In the affection distinguished by emotional exaltation no special treatment is called for. The only indication of treatment in the other type of disease is the necessity of keeping up a full supply of nourishment to the brain; and this sometimes requires that forcible feeding should be resorted to. Where the mental condition is much disturbed, a trustworthy attendant ought to be employed, and the general treatment should always be tonic and stimulating. Removal to an asylum ought in most cases to be avoided. JOHN SIBBALD.

13. **Puerperal Insanity.**—SYNON.: *Insania gravidarum*; *Insania puerperarum*; *Insania lactantium*; Fr. *Folie puerpérale*; Ger. *Puerperalmanie.*

DEFINITION.—Insanity developed during pregnancy, parturition, or lactation.

It has been the custom of authors, till a recent period, to include under this heading the forms of insanity which occur in females during the periods of utero-gestation, the puerperal state, and lactation. It is now frequent to find the term 'puerperal' restricted to the derangements which come on at the time of delivery, or within a short period thereafter. Whatever names we adopt, it is impossible to consider the insanity occurring at these different periods quite independently. The condition of the woman during the whole process, from the time of conception till the child is weaned, represents one of those physiological crises during which congenital or acquired weakness of constitution tends to show itself.

The *insanity of pregnancy* generally takes the melancholic form, and seems to be due in some cases chiefly to a gradually developed anæmia, and in others to disturbance of the abdominal viscera, both of which conditions are frequently associated with mental depression. The delusions which characterise the disorder are generally exaggerations of the anxieties and whims so frequent in pregnancy. In the severer forms the suicidal impulse is frequently developed. The prognosis is generally favourable; but recovery seldom occurs till the termination of the gestation. It may sometimes be expedient to resort to the induction of premature labour. In all cases a torpid condition of the digestive functions should be carefully corrected.

Puerperal insanity in its more restricted meaning is frequently understood to include all derangements occurring at parturition, or within six or eight weeks after it. But it is better to limit the term to what occurs during the first three weeks, as the form of disorder which commences after that period is generally different in character.

ÆTIOLOGY.—Prominent among the causes of puerperal mania are all states of debility, either induced before parturition by want, intemperance, disorders of nutrition, or rapid succession of pregnancies, especially if lactations and pregnancies are carried on simultaneously; or it may be the result of weakness induced during parturition by hæmorrhage or exhaustion. It is liable to occur in primiparæ, when the subjects are either exceptionally young or exceptionally advanced in life. Irritation arising in the pelvic organs, intestines, or mammæ also tends to produce it. Any inordinate mental excitement or depression is apt to bring it on. Where any of these causes are superimposed on hereditary tendency, the danger is of course greatly augmented.

SYMPTOMS.—Attacks of maniacal excitement sometimes occur during actual parturition. They are usually of very short duration, and seem to be directly dependent on the intense suffering which may accompany the pains. The most frequent period of their occurrence is when the head of the child is passing either the *os internum* or *externum*. The more serious phase of the disorder is in its acute stage a variety of acute maniacal delirium. It usually commences within a week or ten days after delivery. Generally it is preceded by sleeplessness, and the patient manifests more or less apprehension of coming evil. Sometimes, however, she awakes delirious from what had been regarded as a healthy slumber. When the attack has commenced, sleep is always either very imperfectly obtained, or is altogether absent. The pulse is quick; the skin often, but not always, dry and hot; and the head throbbing. The eyes are bright, and the face generally pale, with occasional flushing. The expression is generally indicative of alarm or suspicion on the part of the patient. The tongue is dry and furred, and the secretions of milk and lochia are either suppressed or diminished. The bowels are sometimes loose, but constipation is the usual condition. The appetite is uncertain; sometimes it is impaired, but more frequently it is abnormally large. Not infrequently the sense of taste is perverted, and the patient suspects the presence of poison in her food, and persistently refuses it. The breath is often offensive in odour. Sometimes the mental excitement does not reveal itself in language, and the patient may be obstinately taciturn from the commencement. But there is usually a great increase of loquacity, gradually increasing from the beginning, and passing into incoherent raving. Sudden impulsive acts of violence frequently manifest themselves in this disorder, and in these the patient often attempts to destroy herself, her child, or persons for whom she has usually the most affectionate regard. She generally appears to be dissatisfied with those in attendance on her, and often entertains delusions as to their identity. In many cases the mental condition bears a strong resemblance to that of delirium tremens, especially when the patient has undergone privations, or has been intemperate during pregnancy.

DIAGNOSIS.—The only conditions for which puerperal insanity may be mistaken are the typhoid delirium of puerperal fever or pyæmia; and the violent excitement frequently symptomatic of meningitis. In these cases the febrile condition precedes the development of the delirium, while in puerperal mania the mental symptoms show themselves from the first. In meningitis the pupils are generally contracted, and the headache is peculiarly intense; while in

puerperal mania the pupils are usually dilated, and the headache is not a very prominent symptom.

Prognosis.—According to the published statistics of this disease, recovery may be expected in about 70 per cent. of the cases, and a fatal termination need not be anticipated in more than 5 per cent. But as these figures are in a great measure obtained from asylum statistics, and other sources in which only the severer and more persistent forms have been taken into account, it may be fairly assumed that the true estimate would be much more favourable. The duration of the insanity may vary from a few days to a year, after which time the proportion of recoveries becomes extremely small. The great proportion of recoveries takes place during the first six months. The most favourable symptoms, in addition to amelioration of the mental symptoms, are increase of bodily weight, and restoration of the catamenia.

Treatment.—The transitory mania which sometimes accompanies the severer pains of labour does not require special treatment; but anæsthetics may be given as a preventive measure in cases where there is a known liability to such excitement. Special care ought also to be taken after such attacks, until the strength is fully restored, to avoid injury by premature bodily exertion, unnecessary social intercourse, disquieting news, or any kind of mental or moral strain. In the treatment of the graver form of puerperal mania, the chief objects are to remove all sources of irritation, to restore the patient's strength, and to obtain repose. If there is any accumulation of fæces, a smart purgative should be at once administered. If the lochial discharge is scanty, an injection of warm water, containing carbolic acid or some other antiseptic remedy, should be given *per vaginam*. The condition of the bladder should be ascertained, and this organ should be relieved, if necessary; care should also be taken not to allow the breasts to be over-distended. In those cases in which violent excitement does not come on suddenly, an attack may sometimes be warded off or cut short by relieving the sleeplessness which is one of the early symptoms. As a hypnotic about thirty grains of chloral is the best. Opium ought to be avoided, and hyoscyamus and belladonna cannot be relied on. In every case the patient should receive from the first as much light and nourishing food as her digestive powers can properly bear; for it must always be remembered that we have to deal with a condition of anæmia. Both in the first stage, and when the disease is more advanced, everything must be done to promote tranquillity. The room should be darkened, and stillness maintained as far as possible, for the attention of the patient is very easily excited, and both vision and hearing are preternaturally acute. Constant supervision is necessary, however, on account of the tendency to sudden impulsive violence; and the patient should see her infant as seldom as possible. After the maniacal condition has fairly declared itself, the child should be removed altogether, as its presence is sometimes productive of great excitement in the patient, and must always be regarded as attended with risk to itself. In cases where the excitement is somewhat of a hysterical character, bromide of potassium, given in twenty-grain doses at intervals of four hours, may produce good results. Cooling applications to the head sometimes soothe irritation, and induce sleep. Digitalis in small doses, and warm baths, have proved useful. Alcoholic stimulants should generally be given with the food; their effects being carefully watched, and the quantity varied accordingly. Bleeding and every kind of depletion should be avoided. The nursing and attendance should, if possible, be entirely entrusted to strangers, and the patient should not be permitted to see any members of her family. It will sometimes be necessary, especially in the case of poor persons, to resort to asylum treatment; but this ought not to be done if it can be avoided; and with patients in good circumstances it ought never to be necessary in the acute stage of the disease. When the disease becomes chronic, tonics, such as quinine and iron, ought to be given, and a plentiful supply of nourishment should then, as all through the illness, be carefully administered. Patients liable to this disorder should not be allowed without consideration to nurse their children.

The *insanity of lactation* is symptomatic of causes which come into play after the puerperal period, and it ought perhaps to be looked on as symptomatic merely of prolonged anæmia. Acute maniacal symptoms of short duration may occur; but the characteristic condition is melancholia, ushered in by headache, tinnitus aurium, flashes of light before the eyes, and other signs of debility. A suicidal tendency sometimes appears. The treatment required is to wean the child, and generally to save and increase the strength of the patient. The prognosis is favourable in the majority of cases. John Sibbald.

14. **Syphilitic Insanity.**—Among the results of constitutional syphilis, affections of the nervous system are not uncommon; and when the disease affects the brain, the mental symptoms that arise are found in the majority of cases to present a marked similarity in their character. In such cases the mental disorder is generally preceded, as in so many forms of insanity, by distressing sleeplessness. This is followed gradually by increasing depression of mind. Religious anxiety of a peculiarly hopeless character frequently shows itself. Exaggerated self-accusings are earnestly uttered by those who have previously been unusually callous as to the results of their actions. Hypochondriacal delusions are not uncommon, and are frequently associated, in the mind of the patient, with the fact of the syphilitic infection. The feeling of alarm which accompanies these symptoms sometimes developes into a violent excitement, which may be called maniacal. If the symptoms be associated with any of the ordinary signs of syphilitic poisoning —the dry, scaly skin, and the sallow lean face; and especially if any of the characteristic eruptions are present, the mental disease may be expected to yield to treatment by mercurials and iodide of potassium. The mental symptoms which have been here described seem to occur without the existence of any important structural lesions in the encephalon. The development of gummy products within the cranium is frequently

evinced by symptoms similar to those of general paralysis. Headache of very persistent character, giddiness, vertigo, and epileptoid fits occur, accompanied at first with mental depression. During the progress of the disease attacks of acute delirium are not unusual. Sometimes extravagant delusions, such as are frequent in general paralysis, are exhibited; but generally the progress of the disease is characterised by a gradual falling into dementia. The prognosis in such cases must be regarded as unfavourable, but considerable improvement frequently follows the administration of antisyphilitic remedies.

JOHN SIBBALD.

INSECT PARASITES.—Insect parasites are of two kinds, external and internal. The former are described under several affections of the skin (*see* PEDICULI; SCABIES; &c.); the latter are classed with the entozoa. *See* ŒSTRUS; CHIGOE; and DEMODEX.

INSENSIBILITY (*in*, not, and *sentio*, I perceive).—This word signifies either loss of consciousness; or merely loss of sensation in a part. *See* CONSCIOUSNESS, Disorders of; and SENSATION, Disorders of.

INSOLATIO (*in*, in, and *sol*, the sun).—A synonym for sunstroke (*see* SUNSTROKE). Insolation is also used to designate a method of treatment, which consists in exposing the patient to the rays of the sun.

INSOMNIA (*in*, not, and *somnus*, sleep). Want of sleep, or sleeplessness. *See* SLEEP, Disorders of.

INSPECTION (*inspicio*, I look upon).—The technical name for the examination of a patient by the sense of sight. *See* PHYSICAL EXAMINATION.

INSTILLATION (*in*, into, and *stilla*, a drop).—The method of applying remedies to a part in the form of drops. Instillation is chiefly employed in connection with the eye.

INSUFFICIENCY (*in*, not, and *sufficio*, I am sufficient).—A synonym for incompetence. *See* INCOMPETENCE.

INSUFFLATION (*in*, into, and *sufflo*, I blow).—This term is used in the same sense as inflation (*see* INFLATION). It is also a name given to a method of applying remedies in the form of powder to the throat and respiratory passages, by blowing them through a tube into these parts. *See* INHALATIONS, Therapeutic Uses of.

INTEGUMENTS, Diseases of. *See* SKIN, Diseases of.

INTELLECTUAL INSANITY. *See* INSANITY.

INTEMPERANCE, Effects of. *See* ALCOHOLISM; and DISEASE, Causes of.

INTERCOSTAL NEURALGIA.—Any of the dorsal nerves may be the seat of neuralgia, not differing materially in its symptoms from neuralgia affecting other mixed nerves, but especially important from a diagnostic point of view. The pains are paroxysmal; usually affect the region of distribution of the anterior division of one or two of the dorsal nerves; and are confined to one side, most frequently the left.

ÆTIOLOGY.—The female sex, neurotic heritage, and weak general health predispose to intercostal neuralgia. As determining causes may be mentioned blows; the action of cold; local injury to the nerves from the growth of thoracic aneurism; and disease of the vertebræ. Exhaustion from oversuckling, menorrhagia, or leucorrhœa; irritation from cracked nipples; and pregnancy are all occasional but important causes of this form of neuralgia. The pain met with in the chest in early cases of phthisis is not unfrequently due to intercostal neuralgia.

SYMPTOMS.—Pain is complained of at some part of one side of the thorax or abdomen, most often in the region innervated by the sixth, seventh, eighth, or ninth intercostal nerves, and much more frequently in the front or side than behind. It is occasionally found in the axilla and inner side of the arm. The pain may be intermittent, occurring in paroxysms, varying in number from a recurrence every few minutes to only two or three such during the twenty-four hours; or there may be persistent pain of a dull character, interrupted at varying intervals by darts of a very sharp kind, which may sometimes be referred with precision to the course of the neighbouring nerve. The pain is described as 'tearing,' or resembling such injuries as a 'stab of a knife,' or 'boring with a red-hot iron.' The acts of coughing or sneezing, as well as any rapid movements of the body, are apt to increase the distress, but the pain is also independent of these disturbances, and will attack without any such provocation. The pain is sometimes more of a wearing than acute character, and the rest will often be destroyed by it. Painful points are sometimes to be discovered in the following situations:—1. Over a spinous process corresponding to the emergence of the affected dorsal nerve from the intervertebral foramen. 2. At the side of the chest or abdomen, where the lateral branch becomes subcutaneous. 3. Near the sternum or at the margin of the rectus abdominalis muscle, at any part down to the pubes, where the termination of the nerve supplies the skin. The skin in the neighbourhood of the tender points is sometimes so hyperæsthesic that the pressure of the clothes is painful. In epileptics and other highly neurotic patients, intercostal neuralgia is often associated with palpitation of the heart, and the pain is usually referred in a vague manner to that organ. Close examination will show that it is in the chest-wall, and tender points may generally be discovered. The affection is not accompanied by fever. The paroxysms of pain may produce fainting and vomiting. They often cause dyspnœa, with an anxious expression of face, from the inability to draw a full breath without starting the pain.

COMPLICATIONS.—Intercostal neuralgia is sometimes accompanied by herpes zoster. The pain usually precedes the appearance of the eruption, but it is occasionally coincident only, and sometimes comes after it; more often than not it outlasts the eruption, it may be for a long period. In certain cases actual pain lasts but a few days, but is succeeded by an intolerable itching, which is described as being under, not in the skin. This

sensation is said to be felt less in walking than when at rest.

Not unfrequently neuralgia of some other nerves, either at a distance, as the fifth, or anatomically near, as the brachial plexus, occurs as a complication of intercostal neuralgia. This is especially likely in cases happening in the period of bodily decay. It is then too, that the affection may occasionally be accompanied by attacks of angina pectoris.

Diagnosis.—Absence of pyrexia, as shown by the use of the thermometer; the intermittence of pain, and its occurrence irrespective of respiratory movements, although liable to be precipitated by them; and the results of physical examination, serve to distinguish intercostal neuralgia from pleurisy, a condition with which, on account of resemblance in the stabbing character of the pain, it is very apt to be confounded.

From muscular rheumatism it may be discriminated by the presence of the small and characteristic tender points; tenderness of the spinous processes on pressure; and by the pain being found to be not dependent upon movements. The same features serve to distinguish it from myalgia, especially that form which often comes from long-continued use in an unaccustomed manner of some muscle attached to the ribs, as when a person unused to carpentering handles the saw energetically for a long time.

Physical examination and the presence of pyrexia, will preserve from the error of confounding the dull pain often noted in pneumonia with that of intercostal neuralgia.

Pains of a stabbing, plunging, or electric-shock-like character are often experienced in the intercostal spaces in the course of locomotor ataxia, and it is important not to confound this disease with a simple attack of intercostal neuralgia. The distinguishing points are the occurrence of similar pains coincidently or alternately in other parts of the body, especially in the lower extremities; the absence of patellar tendon reflex; and the characteristic gait (if present) —all which mark locomotor ataxia.

Prognosis.—As in the case of other forms of neuralgia, that of the intercostal nerve can hardly be said to be attended with danger, though it must be allowed that in some very rare instances the severity of the pain appears to have actually destroyed life. It is apt, however, to be of troublesome duration, lasting for periods of weeks or months, and liable to recurrence.

Treatment.—Search should be made in other branches of the same nerve, and in the distribution of neighbouring nerves, for any source of irritation which it is possible to remove. Constipation of the bowels should be treated by 3 grains of pilula hydrargyri, followed by some Friedrichshall or Hunyadi Jànos water, repeated for two or three days. Quinine should be given in doses of from five to ten grains twice a day; and if there should be a state of anæmia, steel should be added. Exposure to cold and damp must be avoided; whilst the surroundings generally should be favourable to improving the nutrition and tone. If the pain be very acute, and sleep prevented, morphia may be injected hypodermically in the neighbourhood of the affected nerve, commencing with a dose of an eighth of a grain, and increasing this, if necessary, to a quarter of a grain in the twenty-four hours. This dose should not be repeated, however; and it is better to be satisfied with a repetition of the smaller dose, if required. Small blisters (size of half-a-crown) may be applied to the neighbourhood of the spinal column, near the point of emergence of the affected nerve, one succeeding another as it heals. The continuous voltaic current, from about 10 to 20 cells, Leclanché or Stöhrer, may be applied, one sponge on the spine and the other upon the painful points, in turn. There is no better application than collodion flexile for the herpes zoster which sometimes complicates intercostal neuralgia. *See* Neuralgia.

T. Buzzard.

INTERLOBULAR (*inter*, between, and *lobulus*, a little lobe).—Situated in the tissue between the lobules of any organ. A good illustration is *interlobular emphysema*, in which air occupies the parts between the lobules of the lungs.

INTERMITTENT (*intermitto*, I leave off for a time).—A temporary cessation or suspension, either of a function, for example, of the action of the heart, when the pulse is said to intermit; or of a disease, such as neuralgia or ague, when the symptoms cease for a certain time. *See* Pulse; and Intermittent Fever.

INTERMITTENT FEVER. — Synon.: Ague; Fr. *Fièvre Intermittente*; Ger. *Kaltes Fieber*.

Definition.—A fever of malarial origin, characterised by the sudden rise of temperature during the paroxysm; by the equally sudden fall at its termination; and by the regularity of the times of accession and apyrexia.

Ætiology.—Intermittent fever belongs to the class of malarial or paroxysmal fevers. It is the most typical, and the most common of the class. The human system once subjected to the phenomena of a regular attack of ague in any of its forms, is for the remainder of the life of the person so affected liable to a repetition of the attack, without his necessarily having been exposed afresh to the action of its cause. This tendency is very commonly shown in those who, after long residence in hot and malarial climates, are exposed to the influence of cold, and especially easterly winds, on their return to temperate climates in the spring time of the year. The more the person has suffered from the blood-changes and visceral degenerations described in the article Malaria, the more prone is he to such recurring attacks.

Anatomical Characters. — In the article Malaria the pathology of intermittent fever is fully discussed, including its probable dependence on the presence of the *Bacillus malariæ* in the body. The spleen is enlarged, and in pernicious agues proving rapidly fatal, it is found in a state of softening, often reduced to a state of deeply pigmented pulp. Death is common in malarious countries from rupture of the spleen, the result of blows or kicks, often of no great severity. The liver is usually found somewhat congested aud pigmented, and in cases of long standing it enlarges like the spleen, with

the same increase in the connective tissue. In the algide cases hereafter described, when blood is driven in large quantity into the abdominal viscera, the digestive mucous membrane of the stomach and duodenum is congested and softened. The heart is invariably soft and flaccid, pale, sometimes of a dirty yellowish colour—degenerative changes induced by the combined action of diseased blood and high temperature.

Blood-changes.—Blood-changes sometimes take place both in intermittent and remittent fevers with astonishing rapidity. Army medical officers serving in the Mauritius during the epidemics of malarial fever which prevailed there some years ago, noted that the sufferers were often reduced to a state of complete anæmia in a few hours; the same is the case in Algeria (*see* Malaria). In such cases dropsical affections supervene, often rapidly, and military medical officers there record cases 'proving suddenly fatal from œdema of the glottis.' The blood is changed before any of the usual symptoms of an attack are present—it becomes dark in colour; the serum which separates has a dark brown colour; and when exposed to the air, the coagulum, which is large and loose, does not assume its usual bright-red colour. The white corpuscles are immensely increased in number; and the red corpuscles do not evince their usual tendency to run together in rouleaux.

State of the urine.—The urine contains a large amount of free acid, and retains a highly acid reaction for many days in the hottest weather. In the intervals it is often alkaline. When the paroxysms cease, the watery part of the urine diminishes; and it assumes a deep orange colour, depositing also an abundant sediment of urate of ammonia. This change is often observed by intelligent patients, who learn to appreciate its favourable significance. The late Dr. Parkes has shown that at the first elevation of temperature the urea increases; this lasts during the cold and hot stages; then it decreases, falling below the healthy average. Colin and other French authors note the enormous excretion of urea in malarial fevers both in Italy and Algeria.

Symptoms.—Three forms of ague have long been recognised, namely, the *quotidian*, which recurs in twenty-four hours; the *tertian* in forty-eight hours; and the *quartan* in seventy hours. The term *double tertian* is used when the paroxysm recurs regularly on alternate days, the attacks being alike in severity and duration. Other more rare forms of the irregular type have been described, as the *triple tertian*, with two paroxysms in one day, and one the next; the *double quartan*, with a regular fit one day, a slight one the next, and a complete intermission on the third day. The quotidian is the most common; the quartan the rarest of all—a rule which seems to hold good wherever malarial fevers prevail. The quartan type has been noted from early times for the tenacity with which it clings to its victims.

Premonitory symptoms.—These are much the same as in all febrile disorders, namely pain in the back and lower extremities, languor, lassitude, gastric irritation, loss of appetite, nausea, and sometimes vomiting; with occasionally frequent calls to micturate, the urine being pale and highly acid. Then follow in succession the three stages, the *cold*, the *hot*, and the *sweating*; succeeded by what is technically known as the *interval* or apyrexial period, which lasts for a number of hours, varying according to the type of the disease.

Cold stage.—The patient experiences a sense of coldness in the back; then rigors set in, at first faintly, becoming quickly more distinct, until the teeth chatter, and the patient feels cold all over, and demands to have clothes heaped on him; the skin shrivels, the nails become blue, and he experiences a sensation of intense discomfort. This feeling of cold is, however, only a 'subjective symptom,' for if a clinical thermometer be placed in the mouth or rectum, even before distinct rigors set in, it will indicate a rise in the temperature of from two to three degrees. The skin, from contraction of the superficial vessels, is indeed colder than natural, but from the first the temperature of the blood is above the normal. The phenomena of the cold stage are gastric irritation, a foul tongue, a rapid pulse, and quickened respiration, with a feeling of coldness not confirmed by the thermometer.

Hot stage.—As this sets in, the patient grows warm all over, the face flushes, the pulse rises in frequency and volume, the skin grows hot, and the patient becomes restless, seeking ease to his aching head, back, and limbs in frequent change of posture. The tongue in this stage is usually dry, often bile-tinted; and the bowels are constipated.

Sweating stage.—At first beads of perspiration appear on the brow and face, and the hands become moist; and soon, to the immense relief of the patient, his whole body sweats freely, the temperature begins to decline, and the paroxysm is at an end. The average duration of the paroxysm is from five to six hours, but in severe cases it may last for twelve hours. When sufferers have been exposed to malaria in such places as the mangrove swamps of Africa, 'they will be reminded of what their systems have imbibed in the way of surroundings by the sickly scent of the swamps thrown off in the secretion through the skin.' (Waller.) Both officers and soldiers who came under the care of the writer on their return from the late expedition to the Gold Coast, observed the same fact in their own persons; some were severely nauseated by the unpleasant smell, recalling the stench of the places where the poison was probably taken into their systems.

Temperature.—The rapidity with which the temperature in ague rises to 105°, 106°, and sometimes 107° Fahr., and the equally sudden manner in which it falls when the sweating stage begins, is a very notable and characteristic fact of great diagnostic value. According to Wunderlich, nothing like this is to be seen in any other disease, with the exception of cases of relapse in typhoid, the febrile paroxysms in acute tuberculosis, and pyæmia. As soon as the sweating stage begins, the temperature declines, at first slowly, then as rapidly as it rose; when the defervescence is complete, it will be found one or two points of a degree below the normal, where it remains during the period of apyrexia. If the paroxysms be cut short by quinine, we may still detect at the hour of expected attack a distinct

rise in the temperature, although none of the other symptoms of a paroxysm may occur, and the patient may be hardly sensible of it.

Pernicious agues. — This term is much used both by French and Italian authors, who apply it to cases both of intermittent and remittent fevers, in which certain symptoms are developed, such as delirium, coma, an algide condition; in a word, any serious complication placing the life of the patient in peril. So far at least as intermittent fever is concerned, this pernicious form appears to be more common in the intensely malarious regions of Italy than in India. Such was the experience of the writer, in whose large sphere of observation such grave complications were almost entirely confined to the worst forms of remittent fever, contracted in places notoriously dangerous. The writer is strongly impressed with the belief that the 'pernicious' symptoms, the mental incoherence and delirium, the coma, and the 'algide condition' so much dwelt on by some Italian physicians of the old school, were often the result, not so much of the disease, as of the lowering treatment to which they subjected their patients.

The algide form of 'pernicious' intermittent is sometimes described by writers on the diseases of India as 'ague of adynamic type,' and it was frequently seen and well described by the French military surgeons both in Algeria and in Rome, during the long occupation of that city by the French army. The surface is cold, but, unlike the cold stage of an ordinary ague, the patient is unconscious of the low temperature of the surface. The internal temperature is high, and of this he is aware. There is an immense accumulation of blood in the abdominal viscera, with great thirst. The expression of the patient is tranquil, and his intelligence is intact. 'Il se sent mourir,' says Maillot, 'et l'abattement est tel qu'il se complait dans cet état de repos; son physionomie est sans mobilité; l'impassibilité la plus grande est peinte sur la visage.' (Maillot, Colin.)

Complications.—Intermittents may be complicated by attacks of various diseases of greater or less severity—attacks often governed by climatic causes, by the habits of the individual patient, or by the fact that he has suffered from one or other of such diseases on previous occasions, such as pneumonia, bronchitis, asthma, dysentery, diarrhœa, or epilepsy. It is an old observation that the last-named disease, even in so-called 'confirmed epileptics,' sometimes disappears when the victim becomes the subject of an attack of ague. One very striking example of this kind the writer has seen.

Pneumonia is certainly the most formidable complication met with in intermittent fever. Invalids returning from India or from other hot and malarial climates to high latitudes, unless they are carefully protected by suitable clothing, are prone to suffer from this disease. The rapidity with which consolidation of the lungs takes place in such cases is very remarkable. It is not an uncommon thing to see five or six cases of this kind out of one party of invalids landed at Netley from India, if, on entering the Channel, they have been exposed to cold weather. The pneumonia is generally double, and recovery is rare, the patients either sinking at once, or dying after a longer or shorter illness from pneumonic phthisis. Pneumonia of this type is a common and fatal disease among the malaria-poisoned civil population of Rome during the winter months; and the French military surgeons record its prevalence in the French garrison there at the same season, and also among malarial invalids sent back to France both from Algeria and Rome (*Recueil des Mémoires Méd. Mil.* t. ii. 2e *Série*, p. 268). When pneumonia occurs as a complication of any form of malarial fever, it is one of the gravest import. There is no difficulty in making the diagnosis by the ordinary means.

Diagnosis.—An ordinary intermittent presents no difficulties. The well-marked nature of the paroxysms; the sudden rise of temperature and its equally sudden decline; the splenic enlargement; the discolouration of the skin; the urinary changes described above; together with considerations relating to the place where the disease was contracted; and, above all, the therapeutic test, that is, the power of quinine in preventing the recurrence of the attacks, ought to clear up all doubts.

Prognosis.—This, in ordinary agues, so far as immediate danger is concerned, is highly favourable; death from uncomplicated ague is very rare. The direct mortality from ague, at all events among the European races affected by it, is small; the indirect mortality from the malarial cachexia, occurring either *per se* or as a complication of other diseases, is very great. In complicated or so-called pernicious agues, the prognosis will depend on the extent to which important organs are involved—cerebral, pulmonary, or gastric; much on the stage the disease has reached before the patient comes under treatment; and much, very much, on the nature of that treatment.

Treatment.—Keeping in view the fact that every paroxysm of intermittent fever, particularly in a hot climate, is a step, however short, on the road to the cachectic condition described above and in the article on Malaria, the importance of breaking the recurrence of the paroxysms will be apparent. This, then, is the first indication of treatment; the second is hardly less important, namely, to improve the condition of the blood, and by judicious treatment—therapeutic, dietetic, and climatic—to prevent further degeneration of organs, and, so far as may be, to restore affected tissues to their normal condition.

If, as the writer firmly believes, there be such a thing as a specific disease, intermittent fever is specific. Like all such, it has a certain definite series of phenomena to pass through, which we may assume to be needful for the purpose of destroying, altering, or in some way expelling the poison, or at least such portion of it as may at the time be acting on the system. There is no drug known to science capable of arresting the stages of a true malarial fever once it has entered on the first or cold stage. This doctrine, as Sir William Jenner has admirably stated it in his *Address on the Ætiology of Acute Specific Diseases*, has been taught by the writer, as regards malarial fevers and cholera, in his lectures at Netley for the last twenty years. There is little, therefore, to be said as to the treatment of the stages of ague; they must take their course, the only interference being to supply the patient with the

warm covering so much desired during the cold stage; if this be protracted unduly, to give him draughts of warm tea; and should symptoms of collapse appear in any of the more 'pernicious' forms at the end of the hot stage, to administer such restoratives and stimulants as the case may demand. Excepting in cases where the stomach is oppressed by a recently taken meal, the time-honoured practice of administering an emetic may be safely omitted. The lamented traveller Livingstone, whose experience of malarial fevers was immense, began the treatment of nearly all cases with the following combination: Resin of jalap and of rhubarb, from 6 to 8 grains, with 4 grains of calomel and a like quantity of quinine. According to the great traveller and his hardly less experienced companion, the Rev. Horace Waller, this combination was found very efficacious as the commencement of treatment both in intermittent and remittent fever. In Livingstone's camp his pills were known as 'rousers,' and as such were at once administered to men who, 'from premonitory symptoms, became idle and lethargic.' In about five hours copious dark-coloured motions followed; if these were delayed, recourse was had to a brisk purgative enema. Quinine was then given in 4-grain doses every four hours, until twelve grains were administered in the twelve hours succeeding the purgative medicine. Livingstone and his followers deemed any other mode of dealing with the fevers of Africa to be 'mere trifling.' Common sense points to the necessity of caution in the use of such active purging in men much debilitated by disease or climate, or both, or when the patients are delicate women, or Asiatics, often calling for as delicate handling. It is hardly necessary to add that this sharp treatment is not applicable to those who are labouring, or have previously laboured under dysentery, or any other form of bowel-complaint.

In the 'interval,' energetic efforts must be made to bring the patient under the influence of quinine. At once the most effective and the most economical plan is to administer quinine, in solution, in a ten-grain dose at the end of the sweating stage, and to repeat it in from four to six hours. At least a scruple of the remedy should be given during the interval. If obstinate vomiting interferes with the retention of the quinine, which will rarely happen if the bowels have been well relieved, the quinine must be administered either by enema or by the hypodermic method. The first plan is very efficacious, and is safe; the latter is the most effective, but is not without risk of inconvenience from troublesome ulceration round the site of injection, if a mineral acid has been used to dissolve the quinine: this in urgent circumstances, such as in pernicious agues dangerous to life, or in remittents (as will be explained under the head of that type of fever), might be disregarded were it not that tetanus followed the operation in five cases in one year in the Bengal Presidency, all of them proving fatal. In the face of such a fact, this operation, trivial as it seems, should not be performed on light grounds. The neutral sulphate of quinine, which dissolves freely in water at a temperature of 99° F., does not, so far as the writer's experience goes, cause ulceration. The syringe used for this purpose should be a little larger than that for operations with morphia, and should have a platinum hollow needle.

Quinine, in one or other of the methods advised, should be used until the paroxysms are broken. The remedy should be continued daily, so long as the clinical thermometer indicates a rise in temperature at the time of expected attack, even if there be no sign of a regular cold stage; and within a lunar month from the time of first attack, the patient should be again brought under the influence of quinine for some days. In pernicious agues, or in cases where complications arise, it is in a high degree dangerous to pause in the administration of quinine to use remedies of a depressing kind for this or that set of symptoms. Those who so act will have little success in practice until taught by bitter experience the danger of departing from the golden rule of trusting to quinine. In this way, epilepsy, pneumonia, asthma, bronchitis may have to be met, aided by stimulation of the skin, support from proper food, and stimulants when called for. For many years the writer has urged this doctrine on the attention of young practitioners, and he is glad to see that it is even more strongly insisted on by Trousseau in his well-known lectures.

It is in such cases, and in grave remittents, that the *Tinctura Warburgi* has been found so useful as to warrant a strong recommendation. The active ingredient in this febrifuge is quinine, in combination with a variety of aromatic drugs, which either are now, or were formerly officinal. It is the most powerful sudorific known, and has been found in the writer's hands, and in the practice of many medical officers in Southern India, a remedy of great power in all malarial fevers. After opening the bowels, half an ounce of tincture is administered, undiluted, all drink being withheld: a second dose is given in three hours. It soon produces free action of the skin, the perspiration often having an aromatic odour. It is rare to see another paroxysm follow the use of the tincture. In adynamic cases it should be used in smaller doses, and with some caution, lest its excessive sudorific action should be too depressing.[1]

Substitutes for quinine.—The officers in charge of the Government cinchona plantations in India now prepare from the red cinchona bark, by a very simple and economical process, a preparation known as 'cinchona alkaloid,' which, in somewhat larger doses than quinine, is found to be effectual in checking malarial fever, but this preparation, although very cheap, has fallen into disrepute from the distressing nausea, and even vomiting, it often causes.

Salicylic acid is now largely used as an antipyretic.

[1] Dr. Warburg has communicated to the writer the formula for the preparation of this tincture, which at Dr. Warburg's desire was published in the *Lancet*, and *Medical Times and Gazette*. (See *Medical Times and Gazette*, 1875, vol. ii. page 540.) As stated in the text, quinine proved to be the active ingredient, in combination with a number of aromatic drugs common to ancient and modern pharmacy. It is consistent with the writer's knowledge that this tincture has maintained its high reputation in the treatment of malarial fevers of the most dangerous type, in the hands of Colonel Gordon, in the pestilential regions traversed by him and his officers while carrying out the policy of the Khedive of Egypt along the head-waters of the Nile.

Arsenic has been used for ages, particularly in the East, in the treatment of agues. There is no doubt that it possesses considerable power as a so-called antiperiodic. The French military surgeons, who are obliged to study economy, use it largely, and in doses much larger than are commonly given by British practitioners. They seek, as Boudin expresses it, to oppose an arsenical to a malarial diathesis. In the brow-aches and other neuralgic sequels of malarial fever it is an effective remedy, either alone or in combination with quinine. The alkaline sulphites, so much lauded by Professor Polli, have hitherto disappointed the expectations of British medical officers who have tried them. In the late epidemic outbreak of malarial fever in the Mauritius they were found useless. The sulphate of cinchonine in scruple doses is much praised by Dr. Paul Turner. Biberine was largely tried by the writer in India, and found to be inert. Of late, various preparations of *Eucalyptus globulus*, the blue gum tree of Australia, have been much praised in the cure of ague, and more particularly in the treatment of its sequels. The writer is inclined to fear that this remedy, like many others, has been unduly vaunted. It certainly is often useful in the malarial cachexia, with occasional attacks of ague, but in the acute forms of the disease it is, in the experience of the writer, far below quinine. The best form is that of tincture. Both in France and Germany it is much used for the reduction of enlarged spleens.

Diet.—This should be nutritious and easy of digestion. Dr. Cornish has pointed out how much the mortality from malarial fevers is increased amongst the natives of India by 'starvation treatment.'

Treatment of malarial cachexia.—On the first signs of this condition appearing, the sufferer should be sent to a non-malarial climate. If by sea-voyage, care must be taken so to regulate the diet as to avoid the risk of ingrafting the scorbutic on the malarial cachexia. Remembering also the danger of exposure to cold insisted on already, scrupulous attention to clothing is a point of cardinal importance. According to the writer's experience, one of the most effective means of reviving the action of the skin, improving the condition of the blood, and restoring the spleen and liver to a more healthy condition, is to send those whose circumstances admit of it to Carlsbad or Homburg, where, under proper local medical advice, they may drink the waters and use the baths. The good effects of this treatment are often very marked and lasting. It should be supplemented by a course of the syrup of the triple phosphates of iron, quinine, and strychnia, in half-drachm doses three times a day; which after a time should give way to iron in some more direct form. The Carlsbad water, in combination with that of Friedrichshall, if continued for a sufficient length of time, is often most useful in improving the condition of the abdominal organs, even when the patient can only use them in this country; and the action of the skin may be stimulated with profit by the occasional use of a Turkish bath, or by a wet sheet packing. The writer has long used the ointment of the biniodide of mercury in reducing enlarged spleens, and often with great success. The strength of the ointment is 13 grains to an ounce of lard. Of this a piece as large as a walnut is to be well rubbed in before a good fire. The process is repeated on the afternoon of the same day, and again, if need be, in a fortnight. If ordinary care be taken to watch the effects, and not to use the remedy too often, no ill consequences need be feared. The writer has in this way again and again reduced spleens, extending even into the pelvis, to almost normal dimensions, without producing any of the inconveniences either of the mercurial or iodine ingredients of the ointment.

It is a point of great importance that patients should be placed under the most favourable hygienic conditions, and breathe the purest air available. W. C. Maclean.

INTERNAL EAR, Diseases of. *See* Ear, Diseases of.

INTERSTITIAL (*inter*, between, and *sto*, I stand).—Relating to the interstices of an organ. The term is applied in physiology to the tissue which exists between the proper elements of any structure, namely, some form of connective tissue. In pathology the word is used in connection with *absorption*, when a part is gradually removed without any obvious breaking off; and also to indicate the implication of the interstitial tissues in morbid processes, or their infiltration with morbid products, as *interstitial pneumonia*, *interstitial hepatitis*, &c.

INTERTRIGO (*inter*, between, and *tero*, I rub).—Definition.—A slight inflammation of the skin occurring in the hollows of folds of the integument or joints, where two surfaces lie in contact with each other.

Ætiology.—The cause of intertrigo is not, as might be implied by its name, friction alone; but rather moisture and heat associated with contact and pressure, acting on a sensitive skin. In certain situations the amount of inflammation is liable to be aggravated by the addition of irritant discharges, such as excessive perspiration, urine, and fæcal matter.

Intertrigo is common in infants, in whom it is favoured by abundance of integument, and sensitiveness of skin. For a similar reason it is met with in corpulent persons; but it is not wanting in the emaciated, when there exists a tendency to eczema, or an eczematous diathesis. In infants it is seen in the perineum, extending from the anal fossa behind to the groins in front, and likewise in any other of the deep folds of the integument. Among adults, in addition to these situations it occurs in the axillæ, in the groove beneath the mammæ, and in the flexures of joints.

Description.—The term intertrigo points to a rubbing together or chafing, fretting, or galling of the skin by friction, and no doubt friction may have some share in producing the inflammation; but it is also certain that intertrigo results most frequently from irritation caused by the heat and moisture of the part. Intertrigo has been adopted as an erythema under the name of *erythema intertrigo*, but it very rarely remains at the erythematous stage, having a natural tendency to run on to exudation with the discharge of a muco-purulent fluid, and to be further complicated with excoriations and chaps. In this condition it becomes an eczema and is

very properly treated as such. Indeed, it is more consistent with the genius of modern dermatology to consider it, even from the beginning, as an eczema, under the name of *eczema erythematosum*.

Prognosis.—The prognosis of this affection is favourable as to cure, but uncertain as to time, and in adults it is very apt to degenerate into chronic eczema.

Treatment.—The removal of the cause is the first indication to be attended to in the treatment of intertrigo. This may be effected by careful ablution with soap. The part should then be kept as dry and cool as possible, and dusted with fuller's earth, or any unirritating desiccative powder. Where powder is unsuitable, a lotion of lime-water inspissated with oxide of zinc will be found useful; and if this should prove irritating, zinc ointment, with the addition of a drachm of spirits of wine to the ounce, should be kept constantly applied. Where there is much exudation, it is desirable, as in eczema, to avoid ablution, and confine the treatment to wiping with a soft cloth previously to each repetition of the zinc ointment. Constitutional symptoms are rarely present in intertrigo, but should such arise, the indications to be considered are regulation of the digestive organs and associated functions; a suitable diet; and tonic regimen.

Erasmus Wilson.

INTESTINAL OBSTRUCTION. — Syn.: Ileus; Fr. *Occlusion intestinale*; Ger. *Darmverschliessung*.

Definition.—Under this term are included all those cases in which the contents of the intestinal canal are obstructed in their onward passage, by causes or conditions occurring within the abdomen or pelvis. Cases in which obstruction is due to causes or conditions affecting protruding or protruded bowel are included under the head of Hernia.

General Remarks.—The subject of intestinal obstruction will be best treated by first discussing the condition in general, and afterwards referring to its various pathological causes under separate and distinct heads.

Frequency.—The comparative frequency with which intestinal obstruction occurs is difficult to estimate. It is by no means a common affection, though less rare, perhaps, than is sometimes supposed or asserted. It is always fraught with danger, and in a very large proportion of cases more or less speedily proves fatal. Brinton estimates 1 out of every 280 deaths from all causes to be due to some form or other of intestinal obstruction. Leichtenstern gives 1 out of every 300 to 500. Brinton's estimate, founded on the results of 12,000 post-mortem examinations, is probably somewhat too high, inasmuch as a larger proportion of cases of intestinal obstruction are likely to have been inspected than of cases of more common and less obscure affections.

Ætiology and Pathology.—Most forms of intestinal obstruction are more often met with in the male than in the female subject. Out of a total of 1,806 sufferers, 1,018 were males and 788 females. But women are more liable than men to suffer from certain forms, as, for example, those which depend upon impaction of gall-stones or fæcal matter; upon compression of the intestine by tumours or displaced viscera; or upon constrictions by peritoneal or other adhesions. Some forms, especially intussusception and volvulus, most frequently occur during infancy or childhood; others, as strictures, at comparatively advanced periods of life.

The causes, or anatomico-pathological conditions which may give rise to intestinal obstruction, vary in nature, in mode of action, and in acuteness and severity of effect. Some are *Congenital*, depending upon developmental abnormalities; others are *Acquired*, resulting from accident, disease, or physiological incapacity. Some act by compression of the bowel from without; some by constriction of the bowel within; and others by blocking its canal. Some come into play suddenly or almost suddenly, and without warning, and at once lead to complete occlusion; the symptoms are most acute, and in the absence of relief, fatal results speedily follow. Some coming into play with almost equal suddenness, and accompanied by almost equally severe symptoms, do not, however, so immediately lead to complete occlusion; some degree of permeability remains for a time; and the chances of relief are somewhat better. Other causes, again, seem to develop slowly; the symptoms in the earlier stages, at any rate, are not acute; the malady takes a chronic course; better opportunities for consideration and treatment are afforded; and fatal results, though they may ultimately ensue, can be longer averted.

The causes of intestinal obstruction may be enumerated as follows, in order as nearly as possible corresponding to the acuteness and urgency of the symptoms, and the imminence of danger to life to which they give rise; and the relative frequency with which they occur may be approximatively estimated by the numbers appended, representing the results of an analysis of 1,839 fatal cases recorded or observed:—

1. **Congenital malformations.**

2. **Internal strangulation** (546).

(*a*) By peritoneal false ligaments or bands, the result of previous inflammatory mischief, either under such bands, or by loops or knots, or in button-hole slits, or by kinking caused by traction, or by the margins of slits or rings produced by adhesions of parts or organs to one another, or to some part of the parietes (219).

(*b*) By the omentum or mesentery (in association with some abnormal peculiarity) by bands or in slits (65).

(*c*) By diverticula or diverticular appendages, as the obliterated omphalo-mesenteric vessels, or by diverticular knots (75).

(*d*) By the appendix vermiformis (42).

(*e*) By twisting or knotting (volvulus) and consequent compression of the bowel by itself, or by its mesentery (106).

(*f*) By the margins of peritoneal pouches (retro-peritoneal hernia, hernia through foramen of Winslow, and other forms of internal hernia) (39).

3. **Impaction of gall-stones** (51).

4. **Intussusception or invagination** (537).

5. **Constriction** (511).

(*a*) By cicatricial contractions of the bowel itself, resulting from injury or ulcerative disease.

(*b*) By peritoneal thickening and contraction, with sometimes matting together of the bowel, from strumous or other form of peritonitis (138).

(*c*) By new growths, innocent or malignant, in the bowel itself (373).

6. Compression.

(*a*) By displaced (and often diseased) viscera.

(*b*) By new growths, innocent or malignant, hydatids, &c., outside the bowel (66).

7. Impaction of foreign bodies or intestinal concretions (78).

8. Impaction of fæcal masses: 'Physiological Incapacity'; *Ileus Paralyticus; Confirmed Constipation, habitual* or *accidental* (78).

SEATS.—Every part of the intestinal tract is liable to be primarily affected by one or other cause of obstruction. But some parts are much more frequently than others, if not almost exclusively, affected by certain particular causes; and in regard to treatment, especially so far as operative measures for relief are concerned, it is often of very great importance to determine not only the cause, but also as nearly as possible the seat of the obstruction. Acute internal strangulation *by bands* most frequently affects the small intestine, *by twisting* the sigmoid flexure. Impaction of gall-stones, with very few exceptions, occurs in the jejunum or some part of the ileum. Compression and traction especially affect the small intestine. Intussusception most frequently involves the cæcum and colon, and next, the ileum. Constrictions due to morbid growths are most common in the large intestine, especially in the lower portion.

SYMPTOMS.—The symptoms and physical signs of intestinal obstruction are as a rule sufficiently constant and characteristic to establish the general diagnosis. But though they vary in acuteness, and in certain other respects, with the cause and seat of the obstruction, it is often very difficult, and sometimes impossible, to determine without exploration the differential diagnosis, however important it may be to do so.

The symptoms and signs commonly presented, the variations met with in different cases, and the special indications afforded by such variations may be stated as follows—the symptoms and signs especially characteristic of each form of obstruction being summarily repeated, or further discussed in subsequent sections.

1. *Pain.*—In a very large proportion of cases of obstruction depending upon most causes pain is the earliest, or one of the earliest symptoms; and in a greater or lesser degree, though it may change in character, and from time to time remit in severity, it usually persists more or less continuously and constantly very nearly to the end. The impaction of a gall-stone or foreign body, the commencement of an intussusception, or the strangulation of a portion of bowel occurring suddenly, is usually signalised by an access of acute, indescribable pain, often 'doubling the patient up,' and sometimes producing faintness, and even collapse. Strangulation by bands or in slits, after a period of incarceration, or as the result of twists, when the bowel is not suddenly gripped as it were, gives rise to pain, which, though supervening somewhat gradually, rapidly becomes almost equally severe. Strictures of the bowel, and obstructions due to the pressure of tumours, displaced viscera, &c., cause—at any rate in the earlier stages—comparatively little pain. Obstruction of the large intestine by impaction of fæces is attended by scarcely any actual pain; the patient as a rule complaining simply of fulness, weight, and discomfort.

The pain experienced varies in its cause and character in different stages. At the onset it is, doubtless, due to the injury immediately inflicted on the serous or mucous coat of the bowel; but it is very speedily increased and maintained, and sometimes probably is started, by the effects of the congestion and distension of the compressed blood vessels on their accompanying nerves. Somewhat later comes the pain associated with distension of the bowel itself; and this is increased, at more or less frequent intervals, by paroxysmal exacerbations of acute suffering, which accompany the futile peristaltic efforts of the intestine to move on the solid, liquid, or gaseous matters accumulated above the obstruction. Such exacerbations of suffering are probably due, not only to tension of the intestinal walls generally, but in some measure also to traction upon the injured parts. At a still later stage, when inflammation is established, the pain and tenderness, localised or diffused, of enteritis and peritonitis supervene.

The pain in the early stages of acute strangulation, or of impaction of gall-stones or foreign bodies, is increased, or if it have temporarily subsided, is rekindled, by pressure on or about the spot corresponding to the seat of the lesion; and often there is little or no general tenderness. In intussusception the pain is often relieved to some extent by moderate pressure. In chronic obstruction there is but little pain and tenderness on pressure; and some degree of relief even may sometimes be afforded by gentle, supporting pressure, diffused over one portion or other of the distended abdomen.

Associated with the actual definite pain, are the general physical anxiety and distress always present to a greater or less extent, and in expression almost characteristic of intestinal obstruction or severe intestinal trouble.

2. *Vomiting.*—Vomiting is a very constant symptom of intestinal obstruction, from whatever cause. It may commence almost simultaneously with the occurrence of the obstruction; in which case it may be regarded as sympathetic, and due to shock associated with the injury inflicted. Or it may come on somewhat later; in which case it depends, in part, upon the forcing backwards into the stomach of the accumulated intestinal contents, their onward progress being arrested by the obstruction, and in part upon reflex irritation associated with injury or inflammation of the peritoneum. At whatever period it may have commenced, the vomiting recurs with greater or less severity at more or less frequent intervals until the termination of the malady, although sometimes comparatively long intermissions occur. As a general rule, the nearer the seat of obstruction is to the stomach, and the more acute the cause, the earlier does vomiting come on, the more severe is it, and the more frequently does it recur. Early, severe, and frequently repeated vomiting indicates obstruc-

tion of the small, rather than of the large intestine. When the obstruction is high up in the small intestine, but below the opening of the ductus communis choledochus, the vomit usually contains an admixture of bile, more or less altered it may be, and is but little offensive. When the obstruction is below the middle of the small intestine, the vomit is commonly 'fæcaloid' in appearance and odour. When the obstruction is in the colon, or even the lowest part of the ileum, the vomit is more or less decidedly fæculent in character, and sometimes contains distinct fæcal masses. It appears to be clearly established that great distension of the intestine may render the ileo-cæcal valve inefficient, to such an extent as to permit regurgitation from the large into the small intestine.

The occurrence of fæculent or stercoraceous vomit was formerly ascribed to reversed or antiperistaltic action of the bowel. The possibility of such reversed peristalsis has, however, been disputed, and the matter may be regarded as at present undecided. Practically, it is obvious that contraction of the bowel on its contents must press them in the direction in which they can most easily go; and if they cannot pass onwards, in consequence of obstruction in front, they must pass backwards in the direction in which the way is open.

3. *Constipation.*—Constipation is of necessity a constant symptom of intestinal obstruction. It may be absolute from the first, or may become absolute after a variable period during which more or less scanty fæcal evacuations may be passed. It must be borne in mind that even after complete occlusion has occurred, there may remain in the bowel below the seat of obstruction some portion of its contents; and the secretions and excretions of the mucous membrane being added, the evacuation of these by natural effort, or by aid of enemata, may give rise to the false idea that the occlusion is not complete, or that relief has been obtained. Often, however, the bowel below the obstruction at once ceases to act, and after death may be found to contain fæces, although the constipation has been absolute. This is more likely to occur when the seat of the obstruction is high up. In intussusceptions, especially in the more chronic cases, the bowel is rarely altogether impermeable from the first, though later it becomes so, from the effects of inflammatory swelling. In such cases, sudden constipation is often followed by a period during which small quantities of fæcal matter, mixed with blood and mucus, are passed, and this is succeeded by absolute constipation so far as fæcal matters are concerned, blood and mucus only being passed. In strictures of the bowel, either simple or from morbid growths, or in compression by tumours, &c., constipation comes about comparatively slowly, and is often only rendered absolute by a twist or kink of the bowel, or by impaction of some portion of its contents. A very constricted condition of the canal, especially of the small intestine, in the absence of accidental plugging, suffices to permit the onward passage of its normal contents.

4. *Abdominal distension and swelling: Meteorism.*—The occurrence of obstruction, from whatever cause, is followed by distension of the intestine above the seat of obstruction, from accumulation of its contents. But the degree of distension, and the rapidity with which it comes on, vary with the cause and seat of the obstruction. In acute internal strangulation distension comes on rapidly and severely; in chronic obstruction it comes on gradually; in intussusception it rarely occurs, at any rate during the early stages. The portion of bowel immediately above the seat of occlusion is first affected, and sometimes its position can be recognised by the 'slight fulness to palpation,' and the 'much more definite dulness to percussion,' presented 'where many of the other indications of obstruction are scarcely perceptible, or even absent' (Brinton.) More or less speedily the distension increases, and the whole extent of bowel above the obstruction becomes affected. The more rapidly distension takes place, and the greater its degree, the more serious as a general rule is the aspect of the case, and the sooner is a fatal result likely to ensue. In the earlier stages, when the seat of obstruction is in the duodenum or high up in the jejunum, the distension is limited to the epigastrium or upper part of the abdomen, the lower parts appearing sometimes sunken. When the obstruction is below the middle of the small intestine or in the cæcum, the distension occupies principally the middle region of the abdomen at first, but gradually extends over into the flanks, the small intestines passing into the regions of the colon. When the hepatic flexure or the first part of the transverse colon is affected, distension appears at first in the right flank. When the obstruction is in the sigmoid flexure or the rectum, more or less speedily after distinct fulness of the left flank the whole region of the colon becomes distended, and the transverse colon often becomes especially prominent, leaving the mid-region of the abdomen below comparatively sunken. But very soon, either by implication of the small intestine from accumulation of contents, or from insufficiency of the ileo-cæcal valve—or more usually, perhaps, from extension of the sigmoid flexure over the front of the abdomen, and doubling down of the transverse colon—the distension becomes general. It must be borne in mind that the colon may be so distended and displaced, as to completely cover in, and conceal from examination, the small intestines. The abdominal distension occurring during the earlier stages of obstruction is characterised by tympanites, and more or less tension of the abdominal walls, with but little tenderness on pressure—sometimes, indeed, moderate pressure affords a sense of relief. Fluctuation is rarely obvious. The distended portions of bowel, as already indicated, can often be made out, and in many cases the peristaltic efforts and movements of the small intestines can be clearly recognised from time to time, through the abdominal wall, by sight and touch. One coil of intestine can be perceived rising up and becoming prominent, and then sinking down and giving place to another; and sometimes waves of action, as it were, seem to pass along a considerable length of bowel. Such movements recur at irregular intervals, and are

accompanied by gurgling noises and sensations (borborygmi), and by exacerbation of suffering. They are most frequently met with in cases in which the obstruction is of a chronic character, and is seated in the cæcum or first part of the colon. They are less commonly recognised when the obstruction is low down in the colon, the sigmoid flexure, or the rectum; and they do not as a rule occur in cases of acute internal strangulation, or in intussusception. They cease when the bowel has become paralysed by continued distension; or when peritonitis has supervened, or rupture has occurred.

Apart from such distension from accumulation of intestinal contents as has been discussed, certain localised swellings in the abdomen, which can often be recognised on examination, are liable to occur in connection with some forms of obstruction. Thus, intussusception commonly gives rise to an elongated, sausage-like swelling. Tumours of various kinds; misplaced viscera compressing the bowel; growths occupying the bowel itself, especially the rectum; and foreign bodies, intestinal concretions, and, though very rarely, gall-stones—all of these may cause swellings perceptible to the eye, or appreciable on digital examination, either of the external surface, or by the rectum or vagina.

5. *Derangement of the urinary excretion.*—In occlusion of the intestine occurring high up, especially in cases of acute strangulation, the excretion of urine is usually diminished to a great extent, and sometimes is almost or entirely suppressed. This may be due in part to the persistent vomiting, and consequent diminution of fluid for absorption (Barlow); in part to some vicarious secretion into the bowel (Brinton); and in part to some reflex inhibitory influence, exerted through the sympathetic nervous system upon the excreting function of the kidneys (Sedgwick, Fagge). When the obstruction is low down, affecting the lower part of the colon or the rectum, there is no marked diminution in quantity; there may even be an excess of limpid urine excreted, with sometimes, however, a difficulty in voiding it.

6. *General aspect, signs, and symptoms.*—In cases of acute obstruction from the first, and in the later stages of chronic obstruction, the general aspect of the patient is more or less characteristic. The countenance is expressive of physical anxiety and distress: the eyes are sunken, the nose pinched, the cheeks hollow, the lips pale or purplish, and the complexion faintly livid; the general surface is pale, cool or cold, and either dry or covered by profuse clammy perspiration; and although the mental faculties are as a rule undisturbed, there is a disposition to torpor, from which the sufferer is from time to time aroused by exacerbations of pain, or recurrence of vomiting. The pulse is small and thin, and towards the end becomes thready. Usually it is increased, but sometimes (for a time at any rate) it may be diminished in rapidity. The temperature is often lowered to a very marked extent, but rises if peritonitis sets in. Sometimes there is more or less dyspnœa, due either to reflex nervous influence, or to pressure upwards of the diaphragm by the distended bowel below, and the latter cause also often gives rise to distressing hiccough. The voice is altered in character, and towards the end is almost or entirely lost. The tongue is red; dry and pointed; or dirty brown and covered by thick tenacious mucus, coloured by vomited material. The patient suffers from severe and constant thirst, which often he fears to assuage, lest vomiting should be provoked. In some exceptional cases death has been preceded by subdelirium and coma; and in others, still more exceptional, by violent delirium and convulsions. In children convulsions occasionally occur at the commencement or during the early stages of intussusception, as well as towards the end, and probably arise from reflex nervous disturbance. The torpor commonly noticed may depend not only on general depression, but also in great measure upon imperfect aëration of the blood, from interference with respiration; and the coma, convulsions, and other nervous symptoms which occur in rare cases, have been attributed to uræmic poisoning from suppression of urine.

7. *Collapse.*—Collapse may occur at the commencement of an acute, or may immediately precede the fatal termination of a more chronic case of intestinal obstruction. When it occurs at the commencement, as in acute strangulation, acute intussusception, or sudden impaction of a gall-stone or foreign body, it is due to the shock of the injury at the moment inflicted; when it occurs after a more or less considerable interval, whether in an acute or in a chronic case, it is usually associated with rupture of the intestine, and extravasation of its contents into the peritoneum.

Diagnosis.—The general diagnosis of intestinal obstruction rests on the history of the case; and on the recognition and due appreciation of the symptoms and signs above discussed. In order to arrive at a right conclusion, not only must all the symptoms be fully considered, but careful and thorough examination of the abdomen must be made, by palpation and percussion of the external surface, and by exploration of the rectum and vagina. Such thorough examination should be instituted, and the differential as well as the general diagnosis made out as clearly as possible at the earliest practicable period, before general abdominal distension or the supervention of complications can have obscured the indications first presented. In some cases it may be desirable to administer ether or chloroform, in order to facilitate the examination by relaxing the abdominal muscles, and to save the patient from needless increase of pain. In all cases in which the symptoms indicate acute strangulation, the rings and openings of the abdominal walls must be carefully examined, and the previous or actual existence of an external hernia inquired into. In cases of chronic obstruction in which occlusion has come about gradually, or is even yet incomplete, it is especially necessary to explore the rectum as thoroughly as possible, by the introduction of the finger, or even of the whole hand. In the female, exploration *per vaginam* is often no less needful.

Various morbid conditions may give rise to symptoms—pain, vomiting, constipation—more or less closely resembling or simulating those of

intestinal obstruction. Among such may be mentioned certain forms of colic, such as hepatic colic or renal colic; ulcerative enteritis, especially of the cæcum and appendix cæci; perityphlitis; and intense peritonitis, such as follows perforation. In these conditions there is arrest of action, but not mechanical obstruction of the intestine; a distinction which it is important to bear in mind. The history and progress of the case, together with due recognition of the more distinctive concomitant signs and symptoms usually presented by each of such conditions, serve as a rule to establish the diagnosis, though it may be often difficult, and sometimes may even remain doubtful.

Course, Complications, and Terminations.—The tendency of intestinal obstruction, from whatever cause, is towards a fatal termination, at an earlier or later period according to circumstances, and with or without the supervention of more or less obvious and extensive complications. But in respect to the more acute forms, there are scarcely any in which relief may not be afforded, sometimes coming about spontaneously as it were, almost as suddenly and unexpectedly as the lesion has occurred, sometimes resulting after an extended period of suffering, and sometimes consequent on the treatment adopted. In the more chronic forms, with the exception of those depending upon impaction of fæces, and some others perhaps (as chronic intussusception), complete and permanent relief is less likely to be obtained; and death, though considerably longer delayed, is almost more certain to ensue sooner or later, in spite of temporary relief afforded by operative measures or in other ways.

The *complications* and *accidents* that are liable to occur and to conduce to the fatal result are:—peritonitis starting from the seat of the lesion, and more or less rapidly spreading and becoming general; enteritis; ulceration and perforation of the bowel; sloughing of the strangulated or intussusceptied portions; hæmorrhage into the peritoneum or into the bowel; pneumonia, due to the entrance of vomit into the air-passages, or to pyæmia from absorption of decomposing and poisonous material; gradual asphyxia from interference with respiration by abdominal distension; uræmia; coma; and syncope from cardiac depression and cerebral anæmia.

In cases of acute strangulation, and others in which the occlusion has been sudden and complete from the first, and in which timely relief has not been obtained, the average *duration* has been found to be from five to six days. But death may occur within a few hours, or not until after the lapse of ten days or a fortnight. In cases of constriction or compression, in which complete occlusion has come about gradually, or even has not been finally established, the duration of life varies greatly according to circumstances and the complications which arise, and it may be prolonged for weeks, months, or even years.

Treatment.—The treatment of intestinal obstruction must necessarily be determined by the cause and the circumstances and conditions of the particular case with which we may have to do—and therefore can be more specially indicated and discussed in the subsequent consideration of the several forms of obstruction. But some general statement of methods of treatment may be not inappropriately given at once, inasmuch as tentative measures for relief are often called for before any definite conclusion as to the precise cause of the trouble can be arrived at.

1. *Purgatives.*—As a rule, when the existence of obstruction is established, and emphatically in all acute cases, violent purgatives are to be avoided. They tend to increase rather than to relieve the mischief. The object should be in the first place to soothe, and not to irritate and excite the suffering part. In cases in which it may have been deemed right to administer a strong purgative in the first instance, (and this is often done before the physician or surgeon is called in) failure of effect decidedly contraindicates the repetition of any similar dose. When all urgent symptoms have subsided, however, and in the more chronic cases, mild laxatives (especially some salines) often prove of great value—but caution in their administration is necessary.

2. *Sedatives.*—In almost all cases of intestinal obstruction sedatives and antispasmodics are demanded; and opium and belladonna, conjoined or separately, are the most useful and reliable medicines we possess. They should be given freely, but with judgment, according to the effect produced. They may be administered by the mouth; or, if the vomiting is severe and frequent, by the rectum, or by subcutaneous injection, in the form of morphia and atropine. In very acute cases the inhalation of chloroform or ether may sometimes be desirable, and may prove at any rate temporarily efficacious in relieving urgent suffering.

3. *Enemata.*—Injections more or less copious of simple gruel, soap and water, with or without the addition of oil, castor oil, turpentine, or ether, or of pure olive oil in quantity, are constantly of great service in cases of intestinal obstruction, not only in establishing the diagnosis, but also in affording relief to a more or less complete extent. In many cases it is advantageous to administer the enemata with the body inverted, or at any rate with the lower part well raised, and at the same time to manipulate the abdomen (*massage—abdominal taxis*), but this must be done with caution. When very copious enemata are deemed desirable, they may be administered more gradually, and probably more safely, by the syphon and hydraulic pressure than by means of the syringe. It has been sought to estimate the seat of the obstruction by the quantity of fluid that can be thrown into the rectum; but as a general rule no satisfactory conclusion can be thus arrived at.

4. *Insufflation.*—In cases of intussusception, insufflation of air by means of bellows has sometimes proved efficacious in affording relief; but in almost all other forms of obstruction this method of treatment has rather added to the distress of the sufferer.

5. *Local applications.*—Hot fomentations and poultices, especially with the free application of local anodynes (solutions of opium, belladonna, hemlock, or aconite), often materially relieve suffering, and thus, as well perhaps as by causing determination to the surface, and lessening in-

ternal congestion, favour recovery. On the other hand, the application of ice-bags to the surface of the abdomen has been strongly advocated, and in some cases has certainly seemed to be productive of benefit. Galvanism to the surface—or with one pole introduced into the rectum—with the view of stimulating the peristaltic action of the bowel, has also been advocated.

6. *Abdominal taxis* (Hutchinson); *massage.*—Careful manipulation of the abdomen, with movement of the body from one position to another, has in some cases proved successful in bringing about relief of intestinal obstruction.

7. *Surgical operations.*—In many cases operative measures of one kind or other are urgently demanded, and seem to afford the only chance of rescue from impending death, or from more or less prolonged suffering. And although the statistical results hitherto may not seem very encouraging, yet careful consideration of the causes of failure in the past, and due regard to recent advances in surgical treatment and appliances generally, warrant the belief that such measures will be adopted more frequently, under more favourable circumstances, and more successfully in the future. The surgical operations demanded in intestinal obstruction may be divided into those which have for their object the removal of the cause of the obstruction, and those which aim solely at affording relief by establishing an opening above the seat of obstruction. The various methods will be best discussed in connection with those forms of obstruction in which they are respectively indicated.

Varieties.—The several varieties of intestinal obstruction, according to the pathological cause of the condition, will now be discussed.

I. Obstruction from Congenital Malformation.—Arrest or modification of the normal process of development, or the occurrence of peritonitis during intra-uterine life, may give rise to congenital constriction, or to defective continuity of the intestinal canal, resulting in more or less absolute occlusion.

Constriction or occlusion of such kind is occasionally, but very rarely, met with in the duodenum at or about the entrance of the common duct, or about the junction of the duodenum with the jejunum; and in some cases has appeared to depend upon valve-like folds of mucous membrane, somewhat resembling enlarged or confluent valvulæ conniventes. The lower portion of the ileum, near the ileo-cæcal valve, or about the point of junction with the omphalo-mesenteric duct, where a bend or twist takes place, appears more liable to be so affected, and instances have been from time to time recorded. The colon, and almost exclusively the sigmoid flexure, is the part of the bowel most frequently constricted by the effects of intra-uterine peritonitis and consecutive twisting; but instances are comparatively rare.

All such classes of cases are of pathological interest, rather than of practical importance. Vomiting of meconium, absence of proper evacuation, straining, convulsions, and evidences of more or less severe suffering, are followed by speedy death, though in some rare instances life has been prolonged for weeks or even months. No treatment can be of avail; and surgical operation can only hasten death, or at best succeed in prolonging misery.

Very much more common, and somewhat more hopeful, are those cases in which there is congenital defect of the lower part of the rectum, or of the anus. They may be divided into—(1) Those in which there is simply imperforate anus, the bowel being closed by a membranous or more or less thick layer of tissue, and forming a distended *cul de sac* above the floor of the perineum: (2) Those in which the anus is formed and leads into a *cul de sac*, which approaches more or less closely to the *cul de sac* of the portion of rectum above: (3) Those in which the lower end of the rectum opens into the bladder, urethra, or vagina.

Symptoms. — Retention of meconium, with persistent straining and sometimes vomiting, or the scanty escape of meconium by the vagina, serve to suggest the probable existence of some such defect, the more precise nature of which can generally be readily ascertained on examination or exploration.

Treatment.—Immediate relief may often be afforded by surgical operation, and in some instances more or less permanent good results have been obtained, and by persevering management maintained; but survival to adolescence or adult age has seldom ensued. *See* Rectum, Diseases of.

II. Obstruction from Internal Strangulation. — The various anatomico-pathological conditions which may conduce to internal strangulation have been already enumerated or indicated. Of these, some depend upon abnormalities or peculiarities for the most part developmental in origin, the existence of which—previous to exploration or post-mortem examination—cannot be predicated or ascertained; others, however, depend upon the results of previous inflammatory mischief or accidents. In every case, therefore, it is important to inquire minutely into the early history of the patient; as well as into the circumstances immediately preceding the strangulation. No better illustration of this can be quoted than that afforded by cases in which strangulation has been caused by omentum adherent to the sac of an old reducible hernia.

The *small intestines* are especially liable to become strangulated by bands or adhesions (peritoneal false ligaments), they having been found to be so affected in upwards of 90 per cent. of such cases. Bands, sometimes rounded and thread- or cord-like, sometimes broader and flattened, are met with from time to time, stretching from one part of the mesentery or omentum to another; but oftener attached by one extremity to mesentery or omentum, and by the other to some portion of bowel (comparatively rarely to the large intestine), or to the abdominal wall. Very rarely indeed are they found passing from one portion of bowel to another. The bowel may become incarcerated under or behind such bands (not in front between them and the yielding anterior abdominal wall), or it may be encircled by them, and they may be looped or even knotted or twisted round it; or, again, the bowel may become so kinked by the traction of a band adherent to one point

as to lead to its practical occlusion. The broader adhesions sometimes present slits, in which portions of bowel may be caught. Similarly, ruptures or slits may occur in the omentum or mesentery, or even in very rare instances in the suspensory ligament of the liver or broad ligament of the uterus; and these structures, especially the omentum, by adhesions may constitute broad or narrow bands, under which incarceration may take place, or by which portions of bowel may be surrounded and strangulated. Diverticula, and diverticular appendages (the obliterated omphalo-mesenteric vesels, &c.), by adhesion or by looping, and the appendix cæci, either adherent, usually by its extremity, or spirally elongated and twisted, may lead to a like result. It is worthy of note that by these, as by the foregoing conditions, the small intestine is most frequently affected. So also in the various forms of internal hernia (hernia into the foramen of Winslow, into peritoneal pouches, mesocolic, duodeno-jejunal, retro-peritoneal hernia, &c., all of which are very rare), it is still the small intestine that is most frequently involved.

Internal strangulation of the small intestine, depending on the several causes thus indicated, is most commonly met with during early adult life, the average age being about twenty-two years; and one sex does not appear to be much more liable to suffer than the other, except in the case of strangulation by diverticula, which has been observed about twice as frequently in the male as in the female subject.

The *large intestine*, as might be expected, is much more liable to become strangulated by torsion or twists than the small, and the sigmoid flexure is the part most frequently affected. Out of 106 cases, in 65 the large intestine (in 60 of these the sigmoid flexure) and in 41 the small intestine was found involved. The intestine may be twisted about its mesocolic or mesenterial axis, or one loop of intestine may be intertwined with another. In conjunction with the twisting there may be falling over, as it were, and dragging down, due to the weight of the intestinal contents. Twists of the intestine occur most frequently during the later periods of middle, or during advanced life. Their occurrence is favoured by original peculiarities in the length and disposition of the peritoneal folds, or by corresponding peculiarities acquired as the result of the stretching and relaxation which accompany the changing condition of parts at different periods of life.

The occurrence of internal strangulation is determined by the entrance of a portion of bowel into some such dangerous position as has been indicated, and its retention there. This may be due to a relaxed condition of the bowel—it may be after diarrhœa—and pressure upon it by the action of the abdominal muscles during some strain or twist of the body; to undue and irregular movement of the bowel itself; to the weight and dragging of fæcal matter accumulated at one part, and the futile effort of the bowel above to move it onward; or to some accidental circumstance that can neither be ascertained nor defined. Absolute strangulation may occur suddenly and at once; or may be brought about only after an appreciable period, by the consecutive swelling of the incarcerated or twisted bowel.

Symptoms.—The symptoms of internal strangulation closely resemble those of strangulation of external hernia; but often they are more acute, and unless relief is obtained, lead more speedily to a fatal result.

Intense abdominal pain, generally in the mid-region; not infrequently accompanied by collapse, either at the very commencement or very early supervening; severe and frequent vomiting, soon becoming more or less distinctly fæculent; abdominal distension, at first localised, rapidly becoming more or less general; constipation, with urgent desire and vain effort to evacuate the bowel—all coming on without warning in an apparently healthy subject, constitute a group of symptoms sufficiently characteristic. As the case progresses, these symptoms persist, increasing, or, in some respects, intermitting or decreasing in severity according to circumstances, and becoming more or less masked, modified, or added to by the symptoms of the complications already indicated as likely to arise, until either relief is obtained, or death ensues.

Cases have occurred from time to time in which all, even the most severe, symptoms of internal strangulation have been present, but in which relief has come about almost as suddenly as the distress has arisen; and it would seem that in such cases, after a period of rest, either by the aid of treatment or otherwise, the strangulated bowel has, as it were, recovered itself, and released itself from its entanglement, or reversed its twist. But such cases are rare, and very much more frequently it happens that death results, either very quickly from shock, or within four or five days from intense peritonitis, following, or without rupture of the bowel.

Treatment.—The treatment of a case presenting the above symptoms resolves itself into the question as to whether mere palliative measures should be perseveringly adopted, and the patient allowed to take his chance; or whether an attempt should be made by surgical operation to release the bowel, and thus afford opportunity for recovery (laparotomy), or to give relief by opening the bowel above the seat of obstruction (enterotomy).

During the earliest periods, and before the nature of the case is fully pronounced, there can be no doubt but that palliative measures alone should be adopted. Such measures consist in perfect rest; relaxation of the abdominal parietes by position; the application of either ice or a hot anodyne fomentation (each having its respective merits) over the especially suffering part; and the administration (after collapse has passed) of opiates and belladonna—by the mouth, subcutaneously, or by suppository, or of chloroform or ether by inhalation, as circumstances may indicate. If the physician do not venture to advise, or the surgeon be not bold enough to adopt operative interference, similar measures may be pursued still further, inasmuch as they tend to relieve suffering, and to lengthen the time during which relief may possibly come about. Enemata may be used, but strong purgatives can only add to the distress, and increase the danger of the patient. A little ice may be

sucked with advantage from time to time; but it is worse than useless to attempt to introduce food or medicine in bulk into the stomach, only to be again speedily vomited.

Abdominal taxis.—After one, two, or at most perhaps three days (according to the circumstances and conditions of the particular case) have elapsed, without abatement, or with probable increase in the severity of the symptoms, when the nature of the case is clearly pronounced, and especially if the seat and cause of the obstruction are indicated, surgical operation appears to the writer imperative; and the earlier this is done, the better is the chance of success. The writer cannot forbear expressing in this place the strong feeling and conviction, after long consideration and some experience, that he entertains on this matter. Before proceeding, however, to the use of the knife, it may be well under chloroform to try the effect of changes in the position of the body, and of 'abdominal taxis' by gentle, firm, sustained manual compression of the part of bowel presumably strangulated and distended, and by attempts at movement in one direction or another. The good effects of sustained compression, with the view of emptying the distended bowel of its contents, rather than of pushing it back, in the reduction of external hernia, are not sufficiently generally appreciated and systematically attempted. And further, every surgeon of experience has met with cases of external hernia in which the movements or joltings of a journey to the hospital have resulted in reduction. So it may be with some cases of internal strangulation.

Abdominal section.—If such attempts fail, an incision should be made in the middle line downwards or upwards (as the indication may be) from the umbilicus into the abdomen, of sufficient extent to permit the introduction of the fingers, and the seat and cause of the obstruction sought for. As a rule, it may be better to extend the incision so far as to afford a clear view of the strangulated bowel; but it must be borne in mind that the longer the incision the more, probably, will the distended bowels protrude, and the greater will be the difficulty in replacing and retaining them. Any constricting band that may be discovered may then be divided, and the bowel released, or a twisted portion may be restored to position. The chief difficulties likely to occur arise from the protrusion of distended bowel, which is apt to hinder proceedings. Punctures may be made by a fine trocar and canula; but all such punctures should be carefully closed by ligature or suture. The chief immediate danger is that of giving way of the bowel at the seat of strangulation at the moment of release, and extravasation of its contents; but in cases in which this happens, it is almost certain that similar rupture would have speedily occurred if matters had been allowed to take their course. Any such opening in the bowel should be at once closed by suture, and every effort made to prevent extravasation into the peritoneal cavity. It has sometimes been found desirable to attach the edges of the ruptured portion to the abdominal parietes, with the view of establishing an artificial opening.

In cases in which there has been an external hernia, it may be preferable to make the incision in the groin, and to extend it upwards as far as may be needful. In several such cases (four in the writer's own experience) the cause of strangulation has been found to be omentum adherent to the sac of the old hernia, division of which up in the abdomen has resulted in release of the strangulated bowel. After the operation the abdominal incision should be carefully closed, and the patient kept for some time thoroughly under the influence of opium.

It must be admitted that the statistics of operations for internal strangulation do not seem encouraging. In 61 out of 95 recorded or observed cases death followed more or less speedily, and in 34 only did recovery take place. But the causes of failure are obvious. In most cases there has been either some error in diagnosis, or the operation has been performed too late, and at a period when recovery under any circumstances would have been hopeless. Increased accuracy in diagnosis; earlier resort to operation; and the adoption of improved surgical methods, among which must be especially urged the use of antiseptic precautions, may be confidently expected to yield better results in the future.

Colotomy.—In cases in which it appears that the lower part of the colon or sigmoid flexure is strangulated by twisting or doubling over, and in which it is deemed inexpedient to perform abdominal section, temporary relief at any rate may be afforded by lumbar colotomy—right or left. Or simple puncture of the colon by a fine trocar and canula may give relief, temporary or permanent, by affording escape for the flatus.

Enterotomy.—The operation of enterotomy is applicable to cases of chronic, rather than of acute strangulation, and will be subsequently referred to.

III. Obstruction from Impaction of Gall-stones.—Gall-stones may enter the intestine, either after passing down the gradually dilated duct, or after a process of inflammatory adhesion and ulceration between the gall-bladder and the duodenum or colon. It is in this latter way probably that gall-stones large enough to block its canal get into the bowel; and hence in such cases, though there is usually a previous history of more or less suffering in the hypochondriac region (which may assist the diagnosis), yet those paroxysms of pain and the jaundice which accompany the passage of gall-stones down the duct have not been experienced. Having entered the intestine, gall-stones may either pass along until they escape by the anus—sometimes giving but little trouble during their passage, sometimes being temporarily arrested, or damaging the bowel at one point or other, and giving rise to pain, vomiting, deranged action of the bowels, &c.; or they may become firmly impacted, and completely obstruct the intestinal canal. Obstruction from such cause, however, is comparatively rare, occurring in only about 8 per cent. of the cases of acute obstruction. It is met with about four times as often in the female as in the male subject; and almost without exception, or with very few exceptions, after late middle life—most frequently after the age of sixty.

The gall-stones which have been found to cause obstruction have been from one to two inches or more in longest diameter. As a rule they have been single, in some instances conglomerate. In a large proportion of cases they have been impacted in the duodenum or upper part of the jejunum; in some few instances about the middle of the ileum; and, again, in somewhat more cases, in the ileum near the ileo-cæcal valve. Impaction in the large intestine very rarely occurs, and has scarcely ever led to a fatal result, but in some instances it has been attended by very severe symptoms.

Impaction is favoured by natural or accidental narrowing of the bowel, and doubtless is aided or maintained by swelling of the mucous membrane and spasmodic contraction round the stone, as well as by a more or less persistently contracted condition of the bowel beyond it.

Symptoms.—The symptoms following impaction often come on suddenly, and are usually very acute; and death, preceded by all the indications of intense enteritis conjoined with those of acute obstruction, as a rule occurs in five or six days, if it have not occurred earlier as the result of shock. Recovery rarely takes place. In some few exceptional cases, however, relief has come about even after periods of severest suffering, by the release and onward passage of the stone; in some, the bowel has become stretched into a kind of diverticulum, in which the stone has remained lodged, a way by it being left; in some, after adhesion and ulceration, an opening has been formed between the small intestine and the neighbouring part of the colon through which the stone has escaped; and in some, again, after similar processes between the bowel and abdominal wall, the stone has escaped externally, or has been removed by operation.

Diagnosis.—The diagnosis of obstruction by gall-stone is aided by consideration of the age, sex, and previous history of the patient; the character and acuteness of the symptoms; the localisation of the earliest pain; and sometimes by the recognition on examination of a more or less distinct hard lump, corresponding to the obstructing gall-stone.

Treatment.—None other than palliative measures can as a rule be recommended; but having regard to the extreme danger of the condition, and the severe suffering of the patient, the operation of enterotomy would seem to the writer to be justifiable.

IV. Intussusception or Invagination.—By intussusception or invagination is understood the passage of one portion of intestine into the immediately adjoining portion.

Intussusceptions that have given rise to no symptoms during life are not infrequently found on *post mortem* examination, especially of the bodies of children, and those who have died of brain-disease. Such intussusceptions occur *in articulo mortis*, or immediately after death; they are easily reduced, are almost equally easily reproduced or imitated, and are accompanied by no sign of inflammation. They are of no practical import. But their possible occurrence should be borne in mind, lest, when met with, they should lead to false conclusions as to the cause of death or previous suffering.

Ætiology.—Intussusceptions occurring during life, and causing intestinal obstruction, are most frequently met with during infancy or early childhood. About one fourth of the cases on record have occurred during the first year, and more than one half during the first seven years of life. The male subject appears to be more liable than the female, in the proportion of about two to one.

The occurrence of intussusception would appear to be brought about, in the first place, by some irregular or disorderly peristaltic action of one portion of bowel, conjoined with inaction or paresis of another, dependent upon some ill-defined or unascertainable cause or other of derangement. Sometimes it follows diarrhœa or violent straining; sometimes it is associated with the presence of worms, or of masses of imperfectly digested food; and sometimes with the pressure or dragging of some new growth. Having once commenced, the intussusception goes on increasing, more or less continuously, as the result of peristaltic action. The portion of bowel first invaginated, as a rule, advances at the expense of the receiving portion, which turns in to form the middle layer. The length of bowel involved varies greatly in different cases, as a matter of course. But the process may go on until the portions first involved, having traversed the whole length of the colon, may reach, or even protrude or be expelled from the anus.

Anatomical Characters.—As a rule, with but very few exceptions, it is the upper portion of the bowel that passes into the lower. In ordinary cases the intussusception is *complete* and *single*, and thus a transverse section shows three rings of bowel; a longitudinal section, three layers of bowel on each side; the outer and middle layers having mucous surfaces in mutual contact, and the middle and inner having serous surfaces in mutual contact. In some rare cases, however, the intussusception is said to be *incomplete*; in such a funnel-shaped process is drawn down, usually by the dragging of a pedunculated tumour, from some part of the intestinal wall into the canal. In some cases, again also rare, the intussusception is *double*, the whole intussusception-mass being received into another portion of bowel; under such circumstances four rings or layers are shown on section.

Between the middle and inner layers the mesentery, or mesocolon, or both, as the case may be, are also received, and these determine, from the first, peculiarities in the conformation of the intussusception; and the consequent compression of their vessels, and arrest of the circulation through them, bring about complications and more or less characteristic effects, such as congestion and swelling, ecchymosis, and even considerable hæmorrhage.

Almost any part of the intestinal tract may be involved, but some parts are involved much more frequently than others. Thus in upwards of 50 per cent. of the cases, the ileum and cæcum have been found passing into the colon (*Intussusceptio ileo-cæcalis*); in about 30 per cent. the small intestine has alone been involved—the ileum in most of these (*I. ilealis*), the jejunum

in a few (*I. jejunalis*), the duodenum in still fewer (*I. duodenalis*). In some a portion of ileum invaginated in another portion has passed on through the ileo-cæcal valve into the colon (*I. ileo-colica*). In about 12 per cent. of the cases the colon only has been involved (*I. colica*). The rectum, though it constantly forms the receiving layer of an extended intussusception, is very seldom primarily affected, except as the result of the dragging of, or pressure upon some new growth.

Symptoms.—The symptoms of intussusception usually appear suddenly and are very severe. First, there is pain, often most intense and agonising, sometimes like that of colic, sometimes 'straining and tearing' in character, felt most distinctly at a spot corresponding to the commencing lesion. In children convulsions sometimes occur. Vomiting speedily supervenes, and the vomited material is often streaked or mixed with blood, and, sooner or later, usually becomes fæculent. Diarrhœa soon sets in, and, accompanied by severe straining and tenesmus, recurs at frequent intervals. The evacuations, at first fæcal, very early are stained with blood, and soon consist of little more than blood and mucus, with only a slight admixture of fæcal matter, or none at all. The occlusion of the bowel is often not complete at first, but it speedily becomes so from congestion and swelling. After a variable period, some remission in the severity of the symptoms takes place, to be again followed by paroxysmal exacerbation.

On examination of the abdomen, a firm, cylindrical, 'sausage-like' swelling, of greater or less length, can be distinctly felt, and recognised as the intussusception-mass, in almost all cases of ileo-cæcal or colic invagination. In cases in which the small intestine alone is involved, such swelling is much less distinct and smaller, and often cannot be made out at all. When the intussusception has reached the lower part of the rectum, which it may do even by the second day, it can be readily felt, and its character can often be determined on examination *per anum*.

Diagnosis.—The diagnosis of intussusception of the intestine is generally established without difficulty, by the recognition of the signs and symptoms thus indicated, at any rate during childhood, and in the more acute cases. In some of the more chronic cases occurring in adult life, however, it is not always easy.

Course and Progress.—The course and progress of a case of intussusception may be (1) *acute*. Unless relief is obtained, the case will then terminate fatally, either speedily from shock, or within four or five days in children, or within a week or ten days in the adult from peritonitis or exhaustion. Or (2) the case may be *sub-acute*; death occurring within three or four weeks. Or (3) the case may become, or may be from the first, more or less *chronic*, and terminate in death only after a period of weeks or months, from peritonitis, or enteritis, followed or not by perforation; or from wasting and exhaustion. Lastly, recovery may take place after sloughing, separation, and evacuation of the invaginated bowel. The last event, which is of great interest, and, in regard to prognosis, of great importance very rarely takes place during childhood. It follows peritonitic adhesion between the invaginated and receiving portions of bowel, and death of more or less of the former from deprivation of blood-supply. Numerous cases of this nature are on record, varying in detail. In most of them it has been some portion or other of small intestine that has come away. In some, however, the cæcum with its appendix and portions of the colon have been found. Sometimes the sloughed intestine is evacuated in shreds or fragments, sometimes in its entirety. Such separation and evacuation take place, as a rule, in from eleven or twelve days to three or four weeks, and much earlier in the case of the small than of the large intestine. In some instances the adhesions have given way at or immediately after the separation of the slough, and fatal extravasation of fæces has occurred; and in some a permanent stricture has resulted after fair prospect of recovery had been afforded.

Treatment.—*Acute* intussusception, especially in the child or infant, demands prompt and active measures for its relief. Purgatives can only increase the mischief; palliatives are, as a rule, of little or no permanent avail, though opium and belladonna may sometimes do good by relieving pain, checking undue peristaltic action, and thus hindering the progress of the lesion, and affording a possible chance of recovery, or, at least, by rendering the remaining hours of life comparatively free from suffering.

When once the diagnosis is established, resort should be had without delay to mechanical or operative treatment, for in such measures, according to the results of experience, lie the best prospects of complete and permanent relief. First, a copious enema of oil, or oil and thin gruel, should be gently and slowly injected, the body being inverted, and moved from one position to another, abdominal taxis and manipulation being, meanwhile, carefully and systematically carried out; or, in place of liquid injection, insufflation of air by means of bellows may be employed. If the intussusception have protruded from the anus, it should, of course, be first replaced, and if felt in the rectum pushed up as high as may be practicable. Numerous cases are on record in which such means have been attended by success. But should they fail after full and fair trial—and more than three or four attempts should not be made unless signs of improvement in the condition are manifest; then surgical operation—laparotomy—becomes justifiable, and increasing experience encourages its adoption. Laparotomy should be undertaken before there has been time for the formation of adhesions, or the supervention of general peritonitis. The abdomen having been opened, with all due precaution, by median incision of requisite extent, the intussusception is usually found without difficulty, and may be traced upward and downward. Reduction may generally be effected with comparative ease by gentle traction upon the upper part of the invaginated portion, combined with gradual working up of the lower part by manipulative pressure from below upwards upon the receiving portion (Hutchinson). After the operation, the wound must be carefully

closed, an abdominal bandage applied, perfect rest secured, and after-treatment on general principles carried out.

In 15 out of 58 recorded cases this operation has resulted in recovery; in 43 it has been followed by death, although in most of these reduction was effected. It is probable, however, that a much larger proportion of successful than of unsuccessful cases have been published, and the figures must therefore be taken for what they may be worth; they suffice, however, to justify the more frequent and earlier adoption of such means of relief, especially under the protection of antiseptic precautions.

In the more *chronic* forms of intussusception, and especially in the adult, resort to operation is not so urgently called for. Palliative measures, and particularly the administration of opium and belladonna, with enemata from time to time, are often of the greatest service; and, as already indicated, recovery after sloughing of the intussuscepted bowel, or portions of it, not infrequently takes place, although consecutive and dangerous complications may sooner or later arise.

V. **Obstruction from Constrictions.**—The anatomico-pathological conditions involving some portion or other of the intestinal wall, which may give rise to obstruction, have been already enumerated or indicated. Regarding them the following further statements may be made.

1. *Simple cicatricial stenoses* may result from the effects of injuries inflicted by caustic poisons or foreign bodies; such are most likely to be found in the upper part of the small intestine; they are, however, very rare. Similar stenoses may follow the sloughing of intussusceptions; or the ulceration produced by temporarily impacted gall-stones, fæcal masses, or foreign bodies; or dysenteric, tubercular, or syphilitic ulceration of considerable extent and long standing. The dysenteric stenoses are most frequently found about the flexures of the colon; the tubercular in the lower part of the ileum or cæcum; and the syphilitic in the rectum or lower part of the colon. Typhoid ulceration is very rarely followed by stenosis.

2. *Peritonitic thickening and contraction*, with more or less matting together and constriction of the bowel, most frequently involves the small intestine or the flexures of the colon.

3. *New growths of innocent character*—fibromata, myomata, lipomata, and papillomata (benign villous growths)—are from time to time met with, connected with some part or other of the intestinal wall, and causing more or less obstruction, either by themselves blocking the canal, or by leading to dragging down of the part to which they are attached. Such growths often become polypoid. They are (with the exception of myomata and lipomata) most frequently met with in the rectum, sometimes in other parts of the large intestine, very rarely in the small intestine.

4. *New growths of malignant character*—fibrous cancer, forming hard, narrow constrictions, slow to ulcerate, scirrhus, encephaloma, colloid cancer, epithelioma, cylindroma, and sarcoma—are much more common; and from the readiness with which they involve the whole circumference of the bowel, much more rapidly lead to serious obstruction than do those of an innocent character. In about 80 per cent. of the cases such growths have been found affecting the rectum; in about 15 per cent. the colon and cæcum; and in only about 5 per cent. some part or other of the small intestine.

Symptoms.—The various conditions thus described, develop more or less gradually; and the symptoms to which they give rise are chronic in character, and in their earlier stages by no means well marked. Disordered, irregular, and imperfect action of the bowels, and general discomfort occurring from time to time, with intervals of comparative ease, constitute the earliest indications. Later, and after a very variable period, as the constriction increases, the trouble becomes greater and more constant, and the symptoms of obstruction become more pronounced. In most cases abdominal distension (meteorism)—localised or general, and accompanied by sensations of fulness, fœtid eructations, shortness of breath, and pains in the back, varying in degree from time to time—comes on sooner or later; and except when the seat of obstruction is in the rectum, the peristaltic movements of the intestines at intervals become very manifest through the abdominal wall. The pain experienced is very variable in character and severity, and is often paroxysmal, with periods of complete intermission. As the case progresses towards a fatal termination, the distress becomes extreme. Absolute occlusion, as a rule, comes about slowly. In some cases it is never completely established; but in other cases it occurs suddenly, from impaction of hardened fæces or undigested food, or from other cause; and in such the symptoms at once correspondingly increase in severity. It is worthy of note that even in cases in which the seat of constriction is in the sigmoid flexure or rectum, the greatest fæcal accumulation and corresponding discomfort are observed in the cæcum.

Diagnosis.—The general diagnosis of obstruction from constriction, as a rule, is not difficult; but the differential diagnosis as to the precise nature of the constriction is often very obscure, except in those cases (the large majority) in which a stricture, or the presence of some new-growth, can be discovered on examination *per anum*. The previous history often supplies important indications, and should therefore be thoroughly investigated.

Course and Terminations.—The course of all such cases, though very variable in duration, is progressively unfavourable, and sooner or later death supervenes, usually from peritonitis with or without perforation, or from exhaustion from prolonged suffering.

Treatment.—The treatment must be determined and varied in accordance with the symptoms and indications presented from time to time. In the earlier stages, soothing and palliative measures should be adopted during periods of exacerbation of suffering; and during periods of comparative relief laxatives may often be given with great advantage. In all cases in which there is reason to suspect the existence of some cause of constriction, the most careful attention to diet,

and the administration from time to time of such medicines as favour a soft, semi-solid condition of the fæces, should be insisted upon.

Operation.—In the later stages resort must be had to surgical operation, and the greatest relief may often be afforded, and life prolonged, by the establishment of an artificial anus by opening the bowel above the seat of constriction, either by incision through the peritoneum—enterotomy; or by post-peritoneal incision—lumbar colotomy, right or left. Laparotomy is altogether out of the question.

In cases in which there is reason to believe that the constriction affects the *small intestines*, enterotomy should be adopted. An oblique incision in the right iliac region, more or less parallel with and above Poupart's ligament, having been made and cautiously carried down through the various structures, the peritoneum is to be opened to a limited extent, and the first protruding portion of distended small intestine is to be seized, and being well pulled out, opened by very limited incision. In the case of the small intestine, it is needless, on account of the semi-fluid nature of the contents, to make a large opening, and it is obviously disadvantageous to do so. The margins of the opening in the intestine are then to be sutured to the margins of the external wound. This operation, especially advocated by Nélaton, has proved successful in affording relief and prolonging life in a considerable number of cases (10 out of 16). One great drawback to it, in the event of prolongation of life, lies in the extreme inconvenience and annoyance the patient suffers from the continual escape of liquid fæces in the part of the body operated upon—an escape which there is the greatest practical difficulty in restraining.

In cases in which the seat of constriction is in the colon or rectum, lumbar colotomy (post-peritoneal enterotomy) is to be performed, on the right or left side according to the indications afforded. The merits of this operation in relieving suffering and prolonging life in such cases, can scarcely be esteemed too highly.

After the establishment of an artificial anus, and the rest from constant irritation thereby afforded, the constricted bowel may recover to a certain extent its permeability.

VI. **Obstruction from Compression from without.**—Various viscera, enlarged and displaced as the result of disease—especially the uterus and ovaries, and in rare instances the spleen, the pancreas, and even the kidney; tubercular or cancerous glands; tumours of the omentum or other parts of the peritoneum; tumours growing from one part or other of the abdominal or pelvic parietes, or from the contained viscera; hydatid cysts, &c., may so compress a neighbouring portion of bowel as to lead to obstruction, which either may be brought about gradually, or from some accidental cause may be suddenly determined.

Symptoms.—The symptoms more or less closely resemble those of obstruction, chronic or acute, arising from other causes.

Diagnosis.—Careful examination of the abdomen, including thorough examination *per vaginam* and *per anum* (sometimes the introduction of the whole hand into the rectum is especially likely to be useful), together with the history of the case, and the consideration of the collateral signs and symptoms, will generally suffice to establish, approximatively at any rate, the diagnosis of obstruction of the bowel from external compression.

Treatment.—The treatment of this condition consists, first, in the removal of the cause, if practicable; secondly, if this should be impracticable, in relieving the obstruction. By altering the position of the body, the displaced viscera may sometimes be so moved as to cease to compress the bowel; tumours, uterine and ovarian especially, may be taken away by operation; hydatid cysts may be tapped; and thus relief may be afforded. Or again, by manipulation or by the effects of copious enemata, the bowel itself may be so moved as to be no longer compressed; or after a period of rest, under the influence of sedatives, it may release itself. But if none of these measures should be applicable or successful, and if the symptoms of obstruction be severe, resort to one or other of the operations (laparotomy, enterotomy, or colotomy) already discussed, may become needful. In some cases, of this class especially, relief has been afforded, and the bowel has recovered itself, after puncture by fine trocar and canula and aspiration. The ultimate prospects must depend upon how far the compressing cause can be removed.

VII. **Obstruction from Impaction of Foreign Bodies, Intestinal Concretions (Enteroliths) &c.**

a. Foreign bodies in bulk, such as bones, coins, buttons, knives, forks, pins, needles, &c., accidentally or intentionally swallowed, occasionally find their way on from the stomach into the intestines. In a considerable proportion of cases they pass on, and are evacuated *per anum* without very much inconvenience; in some cases they give rise to enteritis and various other intestinal troubles; in some rare cases they lead to more or less complete occlusion, with acute or subacute symptoms.

Symptoms.—The symptoms of impaction of foreign bodies in the bowels vary with the extent of injury inflicted, and the degree of obstruction occasioned.

Diagnosis.—The diagnosis of such cases rests on the history, and on the recognition of the presence of the foreign body on palpation of the abdomen, or examination *per rectum*.

Treatment.—The treatment of this condition must be determined by the general circumstances and urgency of the case. As a rule, purgatives can only do mischief. Soothing remedies give temporary relief, and favour the gradual onward passage and ultimate expulsion of the foreign body. If absolute impaction has clearly taken place, and the symptoms are urgent, enterotomy and extraction may be justifiable, or even imperative. The wound in the intestine may either be carefully closed by suture, and the bowel returned; or its edges may be attached to those of the external wound, and an artificial anus temporarily established. In some instances, such procedures have been encouraged and favoured by the previous formation of inflammatory adhesions between the bowel and the parietes.

b. Foreign bodies—as hair, &c.; indigestible constituents of the food—as the skins, seeds, and stones of fruit (the husks of cereals, and oats especially), orange-pulp, and the curd of milk in young children; and some medicinal substances—as magnesia, chalk, oxide of iron, &c., swallowed bit by bit from time to time, may accumulate in some part or other of the bowel. Becoming matted or felted together, and agglutinated by the intestinal mucus and other secretions, these bodies may form rounded masses, which sooner or later may give rise to more or less complete obstruction. Such masses constitute the large proportion of the so-called 'intestinal concretions' in the human subject.

c. In some rare instances, however, hard stony concretions (*enteroliths*), consisting for the most part of phosphates of lime and magnesia with organic material, and resembling those not infrequently found in some of the lower animals, have been met with. These usually have as a nucleus some foreign body, or portion of hardened altered fæces.

Intestinal concretions are almost invariably found either in the cæcum or in the rectum. Their presence may commonly be recognised on examination. They are, as a rule, slowly formed, and only give rise to complete occlusion after a considerable period, during which repeated attacks of more or less persistent abdominal discomfort and distress have occurred. Death may be brought about by gradual exhaustion, or by the effects of inflammation with or without perforation; or recovery may follow the evacuation of the concretion, either *per vias naturales*, or through an ulcerated or artificial opening.

Foreign bodies introduced into the rectum, or which have passed down and there become impacted, and concretions similarly situated, may be removed *per anum*.

VIII. **Obstruction from Impaction of Fæces.**—Habitual or accidentally prolonged constipation may lead to definitive obstruction by impaction of fæcal masses, conjoined with paralysis and inaction of the bowel from distension, and contraction of the empty portion below. Sometimes the occlusion is rendered more absolute and irremediable by the doubling or dragging down of the bowel by the weight of its contents. The seat of the obstructing fæcal mass is usually the sigmoid flexure or the rectum, but corresponding accumulation is at the same time often found in the cæcum. This cause of obstruction is most frequently met with in advanced life, and especially among lunatics or idiots.

Symptoms.—The symptoms of fæcal impaction are characterised by their chronicity; and complete occlusion as a rule comes about slowly. There is little or no actual pain during the early stages, and even during the later stages, in the absence of complications, it rarely becomes acute. Vomiting is altogether absent at first, or slight and rare; towards the end, however, there may be fæcal vomiting. Abdominal distension only comes about gradually. Absolute constipation is only slowly established, and sometimes is preceded by more or less frequent scanty diarrhœa-like evacuations. The fæcal mass can sometimes be felt on abdominal examination, and much more often on rectal exploration, which in such cases should always be thoroughly carried out.

Diagnosis.—The diagnosis of such cases is determined generally without difficulty by the history; by the absence of acute symptoms; by the process of exclusion of other causes of obstruction; and by the aid afforded by physical examination.

Course.—In a considerable proportion of cases of this kind relief may be afforded by appropriate treatment. In some cases, however, death ensues from gradual exhaustion; in others from chronic peritonitis; and in others from ulceration of the bowel, followed or not by perforation and acute peritonitis.

Treatment.—In this form of obstruction of the bowels, very copious enemata, administered through a long, soft tube, carefully introduced and insinuated onwards as far as practicable, are especially useful. Such enemata—consisting of thin gruel, soap and water, oil, with or without turpentine, to the extent of two or three pints or more, should be given and repeated at intervals as indicated. Or a stream of warm water from a vessel raised to a height, through a long tube, may be advantageously made to play upon and wash away, portion by portion, the fæcal mass (Gay). Sometimes the mass may be cleared out of the rectum by the finger or a spoon. In some cases galvanism to the abdominal wall, in some the application of an ice-bag, in others hot fomentations or immersion in the hot bath, may be useful.

In the earlier stages, laxatives or even purgatives, as calomel in a full dose, or castor oil, may often be given with safety and advantage. A teaspoonful of Rochelle salts in a cupful of mutton broth, is an old but often efficacious remedy. In the later stages, and when purgatives have been found to fail or to increase distress, opiates are indicated; and belladonna in large doses seems often to exert a peculiar and beneficial influence.

When relief has been obtained, the greatest care as to diet and after-management is necessary, in order to prevent that recurrence of trouble to which the patient remains liable. *See* Constipation.

Arthur E. Durham.

INTESTINAL WORMS.—This combined term was formerly much employed in medical literature, as an equivalent for the simpler expression *entozoa*, which latter title is far better, more comprehensive, and now in general use. To be sure, nearly all the internal parasites of man, at some time or other during the course of their development, play the part of *intestinal* worms, within either the human or animal host; but since this particular residence frequently constitutes neither the only locality they occupy, nor the principal feature of their life-record, it is well that the use of these possibly misleading words should be discontinued. *See* Entozoa; Parasites; Worms; and Vermes.

T. S. Cobbold.

INTESTINES, Diseases of.—General Remarks.—Morbid affections of the intestinal tract are of very frequent occurrence at all ages; some being limited to certain periods of life, others presenting no such restriction.

The direct exposure that the canal offers to external influences, in the form of ingesta, will account for the causes of a large proportion of cases. So many irritants to disease have thus the opportunity to exert their immediate influence, and produce what may be termed *primary* affections of the canal. On the other hand, since much of the normal physiological work of the tract depends for its performance on a healthy condition of other functions, especially of the blood-circulation and nervous system, any disturbances of these processes will tend to influence injuriously intestinal digestion, and thus give rise to *secondary* diseases of the bowel. And it is evident that an improper preparation of the food in the intestine must in its turn affect the nutrition of the tissues generally, and among others those of the canal itself. In no case is the interdependence of the functions on one another seen more completely than in affections of the digestive apparatus.

For this same reason it is that the symptoms essentially due to any disease of the intestines may be considerably masked by more prominent signs of mischief elsewhere, though secondary to the intestinal affection; whilst in other cases the disease we may be called upon to treat is but an expression on the part of the bowels of a morbid state, primarily connected with some other organ.

Besides the direct nutritive disturbance of all organs and tissues of the body that must obviously follow any morbid condition of the intestinal function, there is a most close sympathy between the processes of digestion and the nervous system; or, in other words, a dyspepsia which may be so slight as practically to produce no apparent alteration in the general state of the body, may yet distinctly affect the mental condition, and all degrees of disturbance, from a mere irritability of temper to a complete hypochondriasis, may result. The frequent association of headache with dyspeptic symptoms is a further illustration of the connection; in reference to which we cannot avoid noticing the very extensive nervous supply that is provided by the sympathetic system to the chylopoietic viscera.

Although structurally continuous with the stomach, and closely associated with it in its working, the intestine nevertheless is exceedingly prone to be diseased independently of that organ, while at other times both suffer together. Certain spots in the course of the tract favour the development of certain diseased states, and it is rare to find the entire length of the canal involved; whilst one portion of the tube, the jejunum, is probably less liable to disease than any other organ of the body.

The indications of intestinal disease are frequently extremely vague and uncertain. The subjective symptoms, such as pain, may be completely wanting in some of the most serious conditions, or out of all proportion to the severity of the case. An ulcer may proceed to perforation, and a fatal result happen, with but a minimum of discomfort, whilst an attack of simple colic may be agonising. Nor is physical examination so fruitful in its results in the case of intestinal disease as it is in the affections of many other organs, though perhaps in no other region is the *tactus eruditus* so valuable. Many of the states to be considered below undoubtedly pass through their whole course without giving the slightest indication of their existence that can be recognised by physical examination. An investigation of the evacuations at present furnishes information within the narrowest limits. From all these circumstances, a diagnosis of many diseases of the intestines is almost a matter of pure inference and conjecture, based upon a careful consideration of all circumstances, with due regard to the value of experience.

In respect to treatment, very much may be done with the means at our command. The removal of causes is in a large proportion of cases easy, and a complete cure may be effected. And whilst some of the remaining cases admit of little or nothing being done for them, a greater number can be partially relieved by palliative remedies.

The several diseased conditions of the intestines may now be discussed, for the sake of convenience, in alphabetical order.

1. Intestines, Abscess in Walls of.—In the course of severe cases of enteritis—phlegmonous—where the inflammatory process affects all the coats of the bowel, and the products infiltrate the different tissues, collections of pyoid cells may be met with, but with no well-defined limit, which may be regarded as abscesses. Such bodies may burst into the intestine, leaving small ulcers; or through the peritoneal coat, and so conceivably cause perforation.

In the chronic enteritis so often met with in scrofulous subjects, the solitary and agminated glands may undergo slow suppuration, and form abscesses which end by bursting into the lumen of the gut.

Such morbid products are rather of *post-mortem* interest, since they give rise to no symptoms during life which will permit of their formation being diagnosed, apart from the general existing enteritis, and are practically incapable of treatment.

2. Intestines, Albuminoid disease of.—The intestines appear to be affected with albuminoid disease next in frequency to the spleen, liver, kidneys, and lymphatic glands, and it is rare for the alimentary canal to show signs of this degeneration until it has become far advanced in the above-named organs. It is stated that the intestines are affected in 42 per cent. of all cases (Habershon).

Anatomical Characters.—As in other organs, the inner coat of the arteries, particularly of those surrounding the solitary and agminated glands, appears to be the starting point of the albuminoid change, from which it gradually extends to adjacent tissues, until the whole thickness of the bowel may be replaced by this material. In milder cases it is limited to the mucous and submucous coats, which in all cases are the first to suffer. Considering the exceeding proneness of the Malpighian corpuscles of the spleen to undergo this change, it is noticeable that the solitary and agminated glands of the intestine, which are of similar structure, should long resist

the degeneration, and in many cases may be quite unaffected. Sooner or later, however, the albuminoid granules appear in these structures, until the whole gland is involved. The mesenteric lymphatic glands are usually implicated; and in severe cases the mesenteric and peritoneal vessels, and even the appendices epiploicæ (Hayem).

The naked-eye appearance of the mucous membrane is that of a pale, thickened, leathery layer, often of a 'peculiar glistening aspect' (Friedreich). The pallor is very striking. When the degenerative process has become extreme, the surface is ulcerated, especially over the follicles, from fatty degeneration and breaking down of the new material, the diminished blood-supply by the constricted vessels leading to this result.

The small intestine, and particularly the lower part of the ileum, is the favourite seat of the disease, which sometimes extends upwards to the duodenum and stomach; the colon is sometimes affected.

Symptoms.—The most prominent symptoms which this condition gives rise to, so far as the alimentary canal is concerned, are diarrhœa and hæmorrhage. Since the other important viscera are always simultaneously affected, other symptoms coexist.

The diarrhœa is rather characterised by fluidity than undue frequency of the stools, though the latter does occur; the evacuations are often greenish from altered blood. It is rare to find either pain or tenderness; and the diarrhœa when once established rarely ceases.

Dr. Grainger Stewart has shown that hæmorrhage from the surface of the mucous membrane, independently of any ulceration, is of frequent occurrence, and he considers it as due to rupture of the diseased vessels.

Treatment.—Enemata of starch and opium are the most efficacious, though their effect is at best but temporary. The writer, however, has seen a case, where extreme degeneration of all the abdominal viscera was present, almost completely recover on removal of the cause, namely, a suppurating joint.

3. Intestines, Atrophy of.—A general atrophy of the intestines accompanies a wasting of the entire body from any serious cause of malnutrition, such as starvation, where the organs are estimated in fatal cases to lose 42 per cent. of their weight, becoming extremely thin and transparent.

Intestinal catarrh, particularly in children, may lead to atrophy of the bowels, even to an extreme degree.

Wasting of parts of the canal are of more frequent occurrence from disease. This is well seen in cases where an artificial anus has been made, the gut below the opening becoming thin and shrivelled. In all cases where any considerable stricture of the intestine exists, the portion beyond the obstruction atrophies more or less. This subject will be found fully discussed by Nothnagel, in the *Zeitschrift f. Klin. Medicin*, IV., 1882, p. 422.

4. Intestines, Catarrh of.—This is a mild form of intestinal inflammation in which, however, the essentials of that morbid process are present, though in a slight degree (*see* Intestines, Inflammation of).

5. Intestines, Contraction of.—The calibre of the intestinal canal may be diminished by the pressure of tumours; by structural changes in the walls; or by displacements of portions of the bowels in invagination, &c. Such causes of stricture are more properly described under intestinal obstructions. *See* Intestinal Obstruction.

The term contraction may be applied to that state of shrinking which the gut is liable to present below the seat of any permanent stricture, whatever its nature, just as the portion of the canal above the obstruction tends to dilate. It is a condition that calls for no interference, being of no practical importance.

A spurious contraction of part of the intestines may be occasionally seen *post mortem*, due to extreme spasm of the muscular coat. Congenital malformations, producing contraction of the canal, may be met with.

6. Intestines, Dilatation of.—The normal diameter of the small intestine may be taken as $1\frac{1}{2}$ inch throughout; and that of the large intestine as gradually diminishing from $2\frac{1}{2}$ inches at the cæcum, to $1\frac{1}{2}$ inches at the upper part of the rectum. But the canal is evidently capable of distension much beyond these limits, as may be recognised when large accumulations of flatus exist. Such conditions, however, may disappear after death, the bowel returning to its proper capacity. These dilatations, therefore, may be regarded as temporary, and it is impossible to say what may be the extreme limit reached and recovered from.

Other forms of distension of a more permanent nature are frequently observed.

Cases have been placed on record by Peacock, Crisp, and others (see *Path. Soc. Trans.*) where extreme distension occurred without any obvious cause, but associated with marked constipation. In one case the colon was uniformly distended to a diameter of six to eight inches; and in another the average diameter of the small intestine was twice the normal. In this case the stomach shared in the distension; and the person had been a large eater, and extremely fat.

In the greater number of cases the dilatation is attributable to the existence of some stricture in the course of the canal. It is rare for any distension to follow an acute obstruction, though it is not absolutely unknown; but a chronic stricture is almost invariably associated with more or less dilatation of the tube immediately above. The length to which this may extend is largely dependent on the duration of the case; and inasmuch as a persistent obstruction is usually located somewhere in the large intestine, it is the colon that is most frequently distended, and this may be so excessive as practically to obliterate the ileo-cæcal valve. The mere accumulation of the contents above the obstruction is doubtless one factor in causing the distension; but a diminished resisting power on the part of the gut probably co-exists, brought about by malnutrition of its textures. The muscular coat of the dilated portions is usually hypertrophied,

while the mucous membrane is thinned and peculiarly liable to ulceration, the decomposing contents furnishing an exciting cause for this result.

The existence of any extreme dilatation may be recognised by inspection or manipulation of the abdomen, especially if the parietes be thin and wasted, as they frequently are in such cases. Fæcal vomiting may of course occur in connection with the existence of a dilated intestine, but this is rather to be attributed to the primary obstructing cause, in the symptoms of which the few indications peculiar to this condition are merged.

Paralysis of the muscular coats, by diminishing the resistance of the bowel, allows of its distension. This is well exemplified in the extreme dilatation from flatus which so frequently accompanies acute peritonitis.

7. Intestines, Gangrene of.

Ætiology.—The immediate cause of the complete death of a portion of the intestine is the complete arrest of the flow of blood through the part affected. This obstruction may be produced by:—

(i.) Embolus of the superior mesenteric artery. Several cases of this condition have been recorded, the emboli originating from the heart.

(ii.) Thrombus of the mesenteric veins. The perfect stasis induced by this cause is of very rare occurrence, but it has been seen to follow invasion of the portal vein by malignant disease.

(iii.) Local constrictions of the bowel. This is by far the commonest cause of gangrene, and is the probable sequence of an invagination or ileus. In these states the vessels are pressed upon by the altered position of the gut, which, with the continuously increasing pressure of the œdema that follows the venous obstruction, leads to complete stasis.

(iv.) The more gradual obstruction to the blood-flow, from constriction of the vessels by diseases of their walls, leads to sloughing, which frequently tends to occur in albuminoid disease of the intestines.

(v.) Sloughing also occurs as a sequence of the inflammatory state, when the process is of such intensity that complete cessation of the circulation takes place in localised spots, usually affecting the mucous membrane only, though occasionally penetrating deeper, ulcers remaining after separation of the sloughs.

Anatomical Characters.—From the nature of the constructive tissues of the intestine, the gangrene which is met with is of the moist variety. The portion of bowel which is affected is at first of an intense red colour, gradually increasing, and becoming purple, even to black. The extreme congestion of the vessels leads to effusion of blood into the tissues, which, however, are uniformly coloured; decomposition rapidly takes place in the stagnant blood, and the products acted on by the sulphuretted hydrogen of the intestines become black, all traces of red colour being soon lost. Meanwhile the mucous membrane and muscular coats are swollen and soddened by the serum and blood with which they are infiltrated, and a dark-black to ash-grey, soft, pulpy mass is finally thrown off from the healthy tissue.

The extent of substance which may undergo this necrosis and be separated is extremely variable, from a mere slough of half an inch in diameter or smaller, to portions of bowel several feet in length. Dr. Peacock records a case where 12 feet were passed in eight portions during a period of three years.

Symptoms. — The occurrence of symptoms whereby mortification of the bowels can be diagnosed is not to be expected. The signs resolve themselves into those of the existing inflammatory state. It is not until the sphacelus has been passed, or that signs of ulceration are manifest, that the existence of gangrene can be ascertained. A very few hours suffice to produce this condition when once the cause is established, and it cannot be either arrested or cured; the separation of the slough is to be desired, though fatal hæmorrhage may be associated with this process. The circumstances of this state preclude any treatment being specially directed towards it.

8. Intestines, Hæmorrhage from.—An escape of blood from the intestines is a sign of certain morbid conditions rather than an actual disease itself, hence the cause of the hæmorrhage must be sought for.

Ætiology.—The causes of intestinal hæmorrhage may be thus indicated:—

α. *Increased blood-pressure.*
Intense hyperæmia or extreme congestion.

β. *Affections of the intestinal walls.*
1. Injuries of the bowels.
2. Ulceration.
3. Vascular growths, hæmorrhoids.
4. Amyloid disease of the walls.

γ. *Primarily altered blood-states—*
1. Purpura hæmorrhagica.
2. Leucocythæmia.
3. Yellow fever and severe intermittent fever.

δ. *Occasional causes—*
Rupture of aneurism into intestine.
Vicarious menstruation.

The mere enumeration of the causes must here suffice. It is obvious that the relative frequency of these conditions differs considerably, and in many cases the cause is at once apparent, whilst occasionally the source of the blood may be more obscure. It would seem from statistics that intestinal hæmorrhage is of more frequent occurrence in males, as gastric hæmorrhage is more common in women; the latter fact being explained by the greater liability of females to ulcer of the stomach, as the former appears to be by the preponderance of males suffering from the determining causes of hæmorrhage, and not that the sex *per se* predisposes to such a result.

Symptoms.— Associated with the symptoms special to the loss of blood, and which are in the main similar to bleeding from any other organ, there are the signs and symptoms of the causal disease. The extent of the hæmorrhage will necessarily largely determine the symptoms, many bleedings being so trivial as to give rise to no appreciable effects, and in extreme cases the loss being so great and sudden as to lead to rapid

collapse and death. Between these extremes all degrees of anæmia, faintness, pallor, giddiness, and failing pulse may be observed. A sensation as of a warm fluid flowing into the abdomen is occasionally complained of, but otherwise hæmorrhage in this situation is possessed of no characteristic feature. The occurrence of the above-mentioned indications in the course of a disease liable to lead to this condition, would point to hæmorrhage, especially if there be a fall in temperature from a previous pyrexial state.

Occasionally the escape of blood is beneficial. This is particularly the case where the cause is a congestion of the intestinal tract, with or without hæmorrhoids. Thereby the fulness of the bowels is relieved, and a more equable circulation is established. In some cases of typhoid fever, contrary to what might be supposed, improvement has been noticed to follow a moderate loss of blood. (Trousseau.)

Except in such cases as when the effusion of blood is so excessive that death takes place before any escapes from the bowel, intestinal hæmorrhage reveals itself sooner or later in the character of the evacuations. Unless the cause be such as an ulceration immediately within the anus, or that the blood be sufficient in amount to escape alteration, when the bright red colour is retained, the fluid is always altered in appearance. The hæmatin is readily affected by the sulphuretted hydrogen in the canal, and converted into a blackened material, sulphide of iron being formed, which stains the fæces; or a black tarry substance is evacuated, being the altered clotted blood (*see* MELÆNA). As a rule, when the blood has undergone this change, the source of it is in the small intestine; blood from the colon—where it is usually due to ulceration—being passed adherent to the fæces. The height of the source, and the duration of its stay in the canal, largely determine the extent of alteration in the effusion.

DIAGNOSIS.—The history of the case; the condition of the patient; and the character of the voided blood, are the points upon which a diagnosis of the cause of intestinal hæmorrhage is to be based.

PROGNOSIS.—The amount of blood evacuated is not a sure guide to forming an opinion of the result. It is difficult to estimate the actual quantity lost, since much may be retained in the bowel. The general condition of the patient, especially the state of the pulse, is of far more importance; whilst allowance must be made for the nature of the cause, not forgetting the occasional favourable import of a flux.

TREATMENT.—In a certain number of cases bleeding from the bowel is quite uncontrollable; in others it is capable of cure; whilst in a third group it is rather to be encouraged. When arrest of the hæmorrhage is desired, rest, both general and local, is essential; the patient should be kept in the recumbent position, as thereby the liability to syncope is averted; and the canal is to be kept quiet by abstinence from food, and the use of opium, to prevent peristalsis.

The active treatment is to be directed to withdrawing the blood as much as possible from the affected region, by means of heat, sinapisms, dry-cupping, &c., to other parts of the body; and to the application of styptics to the bleeding surfaces, or the administration of such remedies as arrest bleeding after their absorption into the blood. Among the agents which, administered by the mouth or rectum, act locally, may be mentioned turpentine in 30 to 60 minim doses, with two or three ounces of starch as an enema. Injections of equal parts of tincture of perchloride of iron and water may be given; or acetate of lead in combination with opium. Tannic acid and the vegetable astringents are usually too slow in their effects to be of much avail. Probably the most effective remedy is ergotin, administered subcutaneously in 2-grain doses dissolved in glycerine, and repeated if necessary. This acts not only by constricting the vessels, but by diminishing the blood-pressure. Bitartrate of potash in doses of two drachms, and the local application of a saturated solution of perchloride of iron in glycerine, are of great benefit in arresting the bleeding of piles; for which purpose also, as well as for vicarious hemorrhage from the lower bowel, the writer has found frequently repeated doses (m\v. to viii.) of tincture of hamamelis of much advantage.

When the hæmorrhage is distinctly the result of engorged vessels, its occurrence should not be checked, provided it be not excessive. Sulphate of magnesia in full doses, with a few minims of dilute sulphuric acid, is then of great service; by determining an effusion of the watery part of the blood, the congestion is relieved and the hæmorrhage is arrested, the patient meanwhile refraining as far as possible from taking fluids.

The giving of stimulants is a procedure that involves careful judgment. Whilst undoubtedly the tendency of loss of blood is to produce death by syncope, it is also true that faintness itself favours the cessation of the bleeding, and, so far as a general direction can be given, stimulants should be avoided, unless there be reason to fear, from the condition of the patient, character of the pulse, &c., that the syncope is excessive. Short of that, alcohol, by temporarily increasing the heart's power, increases the bleeding.

Transfusion of blood, when practicable, should be resorted to in extreme cases.

9. Intestines, Hyperæmia and Congestion of.—The former term is here applied to those conditions of vascular engorgement where the excess of blood is, primarily at least, on the arterial side of the capillaries (active congestion, fluxion, determination of blood); whilst the latter term is restricted to cases where the fulness is caused by some obstruction to the venous flow (passive congestion). Doubtless either of these conditions may lead to the establishment of the other, but it is desirable to consider them separately, not so much for the difference in the causes producing them, as for the great difference in their results.

It should be remembered that even within the limits of health a considerable variation is met with in the degree of vascularity of the alimentary canal. The fluctuating periods of rest and activity undergone by the tube are associated of necessity with alternations of comparative hyperæmia and anæmia, as during the digestion of a meal or during fasting. It is impossible, therefore, to draw any line beyond which the vascu-

lar fulness can be said to be abnormal; as it is equally impossible to say exactly where hyperæmia and normal gland-change end, and catarrh begins.

Anatomical Characters.—The appearances seen *post mortem* are far from being always indicative of what existed during life. For an extreme arterial fulness may completely disappear after death, from contraction of the vessels; whilst venous engorgement more or less completely remains.

Ætiology.—The causes of intestinal hyperæmia are as follows:—(*α*) Mechanical and chemical irritants, foreign bodies, and poisonous drugs. Spices and highly seasoned food, and alcohol; any substance, in fact, which may be swallowed, and at all exceeds the blandest nature, may bring about an abnormal degree of hyperæmia of the whole or part of the canal. These causes act locally and directly upon the vessels.

(*β*) Vaso-motor paralysis of the splanchnic area. If from any cause the normal tone of the mesenteric vessels is diminished, by inhibition or removal of the tonic influence excited by the sympathetic, the vessels dilate and hyperæmia ensues. It is in this way that diarrhœa following certain emotional states is to be explained. The intimate relation which has been shown experimentally to exist between the splanchnic nerves and the vaso-motor system generally, but especially with the cardiac innervation by means of the 'depressor nerve,' whereby any considerable peripheral resistance in the systemic capillary area which impedes the action of the heart is compensated for by a dilatation of the mesenteric vessels, renders it probable that an undue hyperæmia of the intestines is of very frequent occurrence.

(*γ*) Collateral hyperæmia, or the fulness of the vessels of one region caused by contraction of the vessels of another, as in the shrinking of the cutaneous vessels from cold, extensive burns, &c. In such cases the blood, remaining constant in amount, must distend other vessels; and those of the abdominal viscera, including the intestines, are peculiarly liable to become engorged, as explained by what may be called their compensating paralysis.

The causes of passive congestion are the following:—(*a*) A general congestion of the entire intestinal tract will be produced by any of those causes which lead to universal congestion of the tissues, as dilatation of the right heart from lung-disease. Pressure by tumours or other conditions on the inferior vena cava above the liver, or on the portal vein, will bring about the same result. So also will any obstruction to the portal circulation in the liver. This is by far the commonest cause of intestinal congestion, since cirrhosis of the liver, however produced, directly tends to it.

(*b*) A congestion of a portion of the tube occurs when any obstruction exists to the venous flow of that part, as is marked in cases of invagination and strangulation of the bowel. The rarer conditions of embolism of branches of the mesenteric arteries, or thrombosis of the veins, will induce intense congestion. This state also forms a part of the vascular changes undergone by any inflamed part.

Symptoms and Effects.—These conditions may of themselves give no evidence of their existence. But the following results may ensue:—

From hyperæmia, an increased secretion of mucus and other intestinal fluids, often more watery than normal, which with an increased peristalsis, induced by the same irritant that led to hyperæmia, produces a diarrhœa. Provided this over-functional activity be limited to the production of the normal secretions of the part, and increased healthy action only, the condition of hyperæmia is not exceeded; but the passage into catarrh is easy, and persistently sustained arterial fulness will sooner or later pass into that state.

The increased blood-pressure may be sufficient to induce diapedesis of the red corpuscles, or rupture of the capillaries, leading to capillary hæmorrhage, submucous petechiæ, &c.

As regards congestion, the more complete the obstruction to the flow, the greater will be the pressure in the veins, whose thin walls favour the transudation of the serous part of the blood, and so produce an œdema of the mucous membrane and entire thickness of the bowel, with a transudation on both surfaces, into the canal itself and into the peritoneal cavity, the latter being more marked. The fluid effusion in this case is dependent entirely on mechanical conditions, whilst the flow in hyperæmia is mainly the result of increased secreting activity. Hæmorrhage from rupture of the smaller vessels is of frequent occurrence, and may be very considerable.

A prolonged state of congestion—and as a rule the cause is such as to determine a permanent state—leads to certain structural alterations in the tissues of the bowel, from the imperfect nutrition that a chronic venous fulness permits of. The nature of the change is chiefly the infiltration of the mucous and submucous coats with an imperfectly formed connective tissue, which causes a thickening and toughness of the bowels, almost identical with the results of chronic inflammation.

Treatment.—It is seldom that these conditions are such as call for treatment. The hyperæmia is usually of a transient nature; and the cause of congestion is generally irremovable. Aperients, such as jalap, gamboge, &c., are sometimes beneficial, by inducing watery evacuations and so relieving the vessels, but they demand constant repetition.

The treatment of hæmorrhage has been considered; but this and diarrhœa, when due to congestion, are, unless excessive, often beneficial, and are not to be checked.

10. Intestines, Hypertrophy of.—This is always of local occurrence, a general hypertrophy, involving the entire length of the bowel, being practically unknown.

In chronic enteritis the mucous, submucous, and even muscular coats are apt to become much thickened, and though this is partly due to an excessive formation of connective tissue, there is also some actual hyperplasia of the normal textures.

In portions of the intestines above an obstruction, a true hypertrophy of the gut, particularly of the muscular layers, is to be found; and, as

already said, this is usually associated with dilatation of the tube.

It is rare for this condition to be other than inferred during life; it gives rise to no symptoms and calls for no treatment; and when established is rather of the nature of a compensatory lesion.

11. Intestines, Inflammation of.—Synon.: Enteritis; Fr. *Entérite*; Ger. *Darmentzundung.*

Under this term are included all those structural changes in the mucous membrane of the intestinal tract which primarily follow the application of an abnormal irritant, provided that the irritant be not of sufficient intensity to produce absolute destruction of tissue. Such changes will involve more or less all the tissue-elements of the mucous membrane, and may extend to the muscular, or even the peritoneal coat. They are essentially characterised by productive, coincident with destructive features, the former leading to the formation of new material, as pus or connective tissue, the latter to ulceration or gangrene. The inflammatory process may present considerable variety in type. The simplest form, to which the term 'catarrh' may be applied, passes, by almost insensible gradations, from the tissue-changes met with in the course of normal digestion, to a distinct condition of disease. Or it may be that, superadded to the above-named characters of inflammation, are certain specific characters due either to the nature of the cause, or to the predisposition of the tissue affected, or to both, which determine the conditions known as diphtheritic, phlegmonous, dysenteric, &c.

There are thus differences in the severity with which enteritis may occur, both as regards the extent of departure from normal structure, and in respect to the symptoms which arise. But in all cases the essential characters of inflammation are present, which may be regarded as the results of the irritant, *plus* the efforts at repair on the part of the affected tissue.

The morbid process may affect the intestine throughout its entire length, either in common with or independently of the stomach—*general enteritis*; or it may be distinctly limited to certain parts of the canal—*local enteritis*, including duodenitis, ileitis, typhlitis, colitis, proctitis. As a rule the term enteritis is restricted to inflammation of the small intestines.

In respect to duration and intensity, enteritis may be *acute* or *chronic.*

(*A*) **Acute Enteritis.** — Acute enteritis is sometimes called *gastric remittent*, or *infantile remittent fever*—terms it is advisable to discard entirely, since they are frequently applied to very different diseases. Acute enteritis is meant to include all those cases where the essential features of an inflammation are present, varying in severity from a simple catarrh or muco-enteritis, to those severer forms possessed of special features, such as phlegmonous or diphtheritic. The more severe cases, especially in children, are sometimes called simple or English cholera, or *cholera infantum.*

Ætiology.—It is doubtful whether an idiopathic enteritis is ever met with; some cause is generally to be found.

Predisposing causes.—(α) The exposed situation of the intestinal tract to irritating substances swallowed, causes this disease to be one of frequent occurrence.

(β) The structure of the intestinal mucous membrane, with its delicate and susceptible epithelial cells, and slightly protected blood-capillaries, favours the occurrence of those changes which constitute inflammation.

(γ) Age especially predisposes to enteritis. For although it may occur at any period of life, infants and children during the period of dentition are peculiarly susceptible. A moderate intestinal catarrh may almost be regarded as a normal accompaniment of dentition, like to the increased activity of the salivary and other glands at that period. From the moderate it may easily pass into the serious or even fatal degree.

(δ) The season of the year appears to exercise an influence, for during the summer this disease is certainly much more frequent; and particularly so when there is extreme difference between day and night temperatures, or when the heat is associated with much moisture.

(ε) Occasionally this malady would appear to be epidemic.

Exciting causes.—These, whatever their nature, would appear to act by inducing a hyperæmia of the tissues, which thence pass into a state of inflammation.

1. Irritating ingesta of the most varied kind, such as abnormal, ill-cooked, or improperly digested food, and irritant drugs or poisons, often cause enteritis. Of these, improper food is by far the most common, especially during the first year of life. Cow's milk alone may be at that time sufficient to produce it, and it is rare for infants to escape an attack. An excessive flow of bile into the intestine is an occasional cause.

2. Exposure to cold may be followed by inflammation of the intestines, as it may be by inflammation of the lungs, kidneys, or pleura; the factor which determines the particular organ involved is unknown. There would seem to be some other factor than the mere determination to the viscera of an excess of cooled blood from the contracted cutaneous capillaries, which probably affects the nutrition of the tissue-elements *viâ* the nervous system.

The occurrence of inflammation and ulceration of the duodenum which follows extensive superficial burns, cannot be altogether explained by the hyperæmia of the intestines, which is said to follow the superficial injury.

3. Wounds, new-growths, and the mechanical results of intussusception, hernia, impaction of fæces, gall-stones, parasites, and other conditions, will lead to enteritis.

4. Inflammation of neighbouring parts may involve the intestines by extension, as from the stomach, peritoneum, or bile-ducts.

5. The specific poison of diphtheria not infrequently leads to enteritis of a characteristic nature. An inflammatory state of the intestinal mucous membrane is said to accompany or follow the exanthemata, and more especially scarlet fever; and it sometimes complicates septicæmia, particularly when this is of puerperal origin. In such cases the disease would seem to be set up, at least sometimes, by extension from the uterus along the peritoneum.

Anatomical Characters.—It probably never

occurs that the whole length of intestine is the seat of inflammation, and it is not often that even the entire small intestine is so affected. It is far more frequent to find certain tracts, of a few inches or a few feet, involved. Speaking generally, the colon, cæcum, rectum, duodenum, ileum, and jejunum are affected, as regards frequency, in that order. In some situations special features are present, but the essential characters of inflammation always exist, whatever be the site.

Owing to the physical properties of the intestinal tissues, the appearances seen after death by no means necessarily correspond to what actually exists during life. Thus, the hyperæmic state of the mucous membrane, with the increased redness, varying from a more intense pink than normal up to a deep dark red, may leave but a trace *post mortem*, the vessels having become considerably emptied from the constriction of the vessels in *rigor mortis*. An increased vascularity, however, is one of the important features of the state under consideration, and it may sometimes be so intense as to lead to capillary rupture and formation of petechiæ in the mucous membrane. The tissue-elements of the gut, as a result of the irritant causing the inflammation, and with the accompaniment of an increased vascular supply, undergo changes in their appearance and behaviour. Thus the epithelial cells are in a state of cloudy swelling and increased activity in multiplication, each successive progeny approaching nearer and nearer to the embryonic type; the connective-tissue elements are similarly affected, and leucocytes transude into the tissues from the vessels. These new-formed cells constitute pus-corpuscles, which are thrown off from the surface of the mucous membrane, and crowd to a variable depth the tissues of the different coats. If the primary irritant to the inflammation be of a specific character, such as the poison of diphtheria, or of an extremely severe nature, such as an intussusception or hernia, then the new-formed cells become entangled in a fibrinous coagulable exudation from the blood, and form patches of membrane more or less adherent to the surface of the bowel, depending on the depth of tissue involved. In all cases there is some œdema of the intestinal walls from serous effusion, and the free surface of the membrane is covered with a glairy mucus, containing pus-cells, and frequently crystals of triple phosphates.

The epithelium of the follicles of Lieberkühn becomes extremely granular, and proliferates extensively, with the frequent result of blocking up the lumen of the gland, which thus becomes very prominent. The solitary and agminated glands are invariably much swollen, and very often the process of inflammation is most intense in their vicinity. Occasionally the mesenteric glands are similarly affected.

How this inflammation may terminate very much depends on the course; it may subside, and the bowel gradually assume its normal characters with no impairment of function; it may lapse into a chronic state; or it may pass on into ulceration, or even sloughing and gangrene.

To these various degrees of the inflammatory state different terms have been applied in no very definite way. Thus, when the mucous membrane alone is affected, a *catarrh* or *muco-enteritis* is said to exist; whilst the severer form, affecting all the coats, and attended with suppuration, such as occurs in the neighbourhood of an intussusception, is known as *phlegmonous*. When a membranous exudation is found in association with diphtheria, we have a true *diphtheritic* enteritis; and the expression *pellicular* may be more fitly applied to those cases where a similar membrane is formed, though not in connection with the diphtheria poison. Such a state is of not infrequent occurrence on the prominent edges of the valvulæ conniventes, and still oftener of the saccules of the colon, due to the presence of hardened fæces or impacted calculi. Both these latter forms are invariably associated with ulceration. The term *dysenteric* is very indifferently applied to more than one form of enteritis or colitis: the writer thinks it better limited to that form of inflammation due to the specific poison of dysentery, although the morbid appearances of such cases are almost or quite identical with some of the varieties enumerated above, the differences in the cases being dependent on their clinical history.

An enteritis associated with aphthæ is of common occurrence in children.

Symptoms.—That a considerable variation is met with in the kind and severity of the symptoms presented in cases of enteritis, is only to be expected when the great difference in degree and extent of morbid change that is met with is remembered. Whilst the pathological changes that take place in a limited part of the canal are identical with those that may be found in another, to a very large extent the symptoms that arise in the two cases may be widely different. For whereas one patient may suffer from an attack of intestinal catarrh, with but a trifling array of symptoms, another may succumb within a few days. There is no one symptom or even group of symptoms that is absolutely characteristic of the disease; even the general condition of the patient is not constant. In the milder forms of intestinal catarrh there may be slight pyrexia, with thirst and quickened pulse, but these symptoms may be scarcely noticeable; while, on the other hand, in the severe phlegmonous enteritis they are extreme, and the patient is in a state of considerable prostration.

The following symptoms, more or less marked, occur in different cases.

Stools.—Diarrhœa is in some respects the most constant symptom, though, when the affection is limited to the higher part of the canal, and space is given for the reabsorption of the excessive exudation, it may not only be wanting, but there may be actual constipation. The lower down the gut is inflamed, the greater the liability to diarrhœa, which hence becomes a marked character of colitis and proctitis. In the severe forms of the affection a more or less complete constipation may be due to the paralysis of the inflamed bowel, arresting the peristalsis, and allowing of the accumulation of the intestinal contents above the lesion; this is obviously more complete when the enteritis is associated with any state producing mechanical obstruction, such as intussusception, or ileus.

The character of the evacuations is very variable. As a rule they are semi-fluid when diarrhœa exists; or they may consist chiefly of a liquid with a few feculent flakes; but, when time has permitted a partial re-absorption of the fluid part, the stools become more consistent, and in cases of enteritis which are chiefly due to fæcal accumulation, solid, hard masses are passed.

Mucus, in greater or less quantity, is constantly present—being especially abundant in affections of the large intestine and rectum, when it is often discharged as complete tubular casts of the bowel.

Blood is not usual except in proctitis, or unless there be ulceration or hæmorrhoids; and pus is seldom noticed unless the rectum be inflamed.

Owing to the imperfect performance of digestion or absorption, the motions are liable to contain many abnormal constituents—as fat, when the duodenum and upper part of the jejunum are involved, or even masses of food scarcely changed; and the altered character of the intestinal contents, with the products of decomposition, are in themselves important features in maintaining a diarrhœa. As a rule, the discharges are paler than normal, or may be even colourless; the greenish tint so often seen in the enteritis of children is due to altered bile or blood-pigment. The odour is usually extremely offensive or even putrid; though sometimes, when the evacuations are very liquid and colourless, smell may be altogether absent.

Owing to a large production of gases, discharges of flatus are of very frequent occurrence.

Vomiting, except in the severe forms, is not a common symptom of enteritis, unless the stomach be involved. In phlegmonous enteritis, however, vomiting may be persistent, and even stercoraceous; and it is relatively more frequent in children than in adults. Short of actual vomiting, nausea is frequently complained of.

Pain and tenderness.—Pain in itself is a most uncertain symptom, perhaps being scarcely noticeable in the milder forms of catarrh; whilst in colitis, the colicky, griping pains, which may or may not be relieved by pressure, are characteristic. Still more is this the case when the rectum is affected, when the straining and tenesmus constitute one of the most distressing symptoms of the malady. When the peritoneum is involved, the pain and tenderness are marked and characteristic. Both may be generally diffused over the abdomen, or may be local in character, as over the cæcum; in a large number of cases the pain is referred to the umbilical region.

General symptoms.—Among the more general symptoms, or those associated with inflammation of special regions, are the phenomena of the febrile state in a more or less marked degree. The temperature may reach 104° F., or even higher; or in some cases it may be scarcely elevated. The appetite may be unaffected, especially if the upper part of the tract be free from the disease; whilst there may be complete anorexia when the reverse is the case. Thirst is of usual occurrence, and it becomes very marked when the evacuations are abundant and fluid. The tongue indicates rather the general state of the patient, and is a less reliable index of the actual state of the intestinal mucous membrane, than in corresponding affections of the stomach. It may be red, irritable, and glazed; or coated with a thick fur, with the edges and papillæ bright and prominent; in milder cases it can often scarcely be said to be affected.

The character of the pulse varies with the general state. Provided that the pyrexia be extreme, there is the usual dry skin and concentrated urine, with a tendency towards the production of the typhoid state, which usually is reached in fatal cases. In many cases the prostration is excessive, though the mind is usually unaffected to the end, and in a large number of cases there is a very marked irritability of temper. Notwithstanding the intimate sympathy between the alimentary tract and the brain, headache is of rare occurrence in enteritis. A persistent hiccough, presumably of nervous origin, is met with sometimes. In children the disease readily leads to a condition of collapse. The child lies in a languid, almost torpid, state; with the skin of the abdomen intensely hot and dry; whilst the extremities are cold and blue, the face is pinched, and the body generally appears shrunken. Frequently this state is interrupted by attacks of convulsions, especially if dentition be in progress. The child, too, is usually extremely fretful, and maintains an almost constant, short, feeble cry, evidently accompanied with pain.

When the disease affects the duodenum, jaundice, due to closure of the bile-duct, very often occurs. The intimate nervous relation between the rectum and base of the bladder explains the frequency of micturition, so commonly associated with proctitis.

Diagnosis.—The variability and oftentimes vagueness of the symptoms frequently admits of a diagnosis of enteritis being made only by a process of exclusion. The history of improper feeding, whether temporary or prolonged, often indicates the nature of the disease; though it cannot be denied that all rules of a rational dietary are frequently violated, both by children and adults, with apparent impunity.

Diarrhœa alone can by no means be taken to indicate the existence of intestinal inflammation, it being due to many causes which leave the intestines unaffected; and the same may be said of constipation, pain, vomiting, and other symptoms. It is rather to a group of symptoms, with the previous history, that the observer must look. The character of the stools, as already described, often indicates the region of gut affected; and the existence of extreme tenderness and pain, with a hard, quick pulse, and the abdominal decubitus together, point to the involvement of the peritoneum, which an exacerbation of temperature tends to confirm. The distinctive features of typhlitis, colitis, and proctitis have been already described sufficiently to form material for diagnosis in most cases. To distinguish between inflammation of the jejunum and ileum is usually impossible, nor, practically, is it a matter of importance. The history of the case, the course of the temperature, and the characteristic rash and headache, should serve to separate acute enteritis from typhoid fever, for which it is sometimes mistaken.

Prognosis.—This will clearly depend on the degree of severity of the affection, no less than on its seat and extent. Rest, which is of prime necessity to an inflamed organ, is almost incompatible with maintaining the due nutrition of the patient, and this fact renders the prognosis very uncertain.

A simple intestinal catarrh occurring in a healthy subject certainly tends, after a few days, to complete cure; but occurring, as it frequently does, in persons in ill-health, it is far more liable to pass into an obstinate chronic condition. In children, the opinion should be very guarded; for whilst in a large number of cases perfect recovery follows removal of cause and suitable treatment, others, for no very apparent reason, will, in spite of everything, progress to a fatal termination; and this is, of course, more likely to be the case where a strumous or tubercular diathesis exists. Enteritis in different degrees of severity constitutes one of the most, if not the most, important cause of infantile mortality.

In the severer forms, as they affect adults, opinion must be guided by the nature of the cause, and the general state of the patient. Recognising that the unfavourable tendencies of the patient are towards extreme prostration, to perforation with fatal collapse, or to chronic ulceration—according as these conditions are threatened, so may the prognosis be fairly made. The duration of extreme cases rarely extends beyond a few days, when, if death do not occur, the symptoms abate, and recovery, with oftentimes a tedious convalescence, follows, or a chronic condition of disease is established.

Treatment.—Although great variety exists in the degree of severity of the symptoms of acute enteritis, and a corresponding difference obtains in the treatment to be pursued, yet certain general principles may be first laid down, and the more special details adapted to certain conditions afterwards indicated. Inasmuch as the disease is one of a febrile nature, where, among other things, the tissue-waste is out of proportion to the repair, and at the same time the organs concerned with the preparation of the food are those mainly at fault, every effort should be made to minimise the bodily waste. This is best attained by keeping the patient in bed, which also offers the additional advantage of providing a uniform warmth.

As regards diet, in the greater number of cases of acute intestinal inflammation, the appetite is much impaired, even to complete anorexia. Providing the person attacked have been previously in good health, no harm is done by complete abstinence from food for twenty-four or even forty-eight hours. This gives a much better chance of rest to the intestine, and a better opportunity for the removal of any irritant ingesta which may have been the cause of the inflammation. The thirst during this period may be relieved by ice-cold water, with or without a little lemon-juice. It must not be forgotten that, with the mucous membrane and its glands inflamed, the conditions of normal digestion and absorption are materially interfered with, and articles of diet that ordinarily are most nutritious and easily digested, may and do become, under these altered circumstances, positively harmful. The aim in feeding the patient should be to give those materials which are most quickly absorbed, and leave the smallest amount of indigestible residue. Provided that the stomach be implicated—and it is rare that it is not so, either directly or indirectly—meat foods are badly borne; instead of the proteid constituents being digested in the stomach, they remain there and undergo putrefactive decomposition, and thus add fresh irritants to the canal lower down. If, however, as is largely shown by the state of the tongue, the stomach be tolerably free, then meat essences, made thin and allowed to stand till cold, may be given. The nausea or vomiting which is usually present is more easily overcome by giving the nourishment cold; and a few drops of lemon-juice are of great service if added to the beef-tea. Milk is very uncertain in the way it is tolerated by such patients. Occasionally it is impossible to give it, the vomiting or diarrhœa being increased by it; but equal parts of milk and soda-water may constitute sufficient nourishment to last for several days in extreme cases, and may be well borne. Lime-water may be substituted for the soda-water, but, as a rule, effervescing fluids are more grateful. The milk should be as free as possible from cream, for fats in all forms are to be avoided, since the products of their decomposition are extremely irritating. A similar objection, though not to such an extent, may be made to farinaceous foods, for the lactic and butyric acids to which they give rise in the process of pancreatic digestion will further increase any existing inflammation. If given at all, it should be only in small quantities at a time; a remark which equally applies to all other food. Nutrient enemata may be of much use in some cases.

A very great deal may be done for the patient with drugs, both in the relief of symptoms, and in aiding the cure.

It is seldom advisable to check the diarrhœa in acute enteritis; and an aperient to begin with, except evidence exist of there being any peritonitis, or that the cæcum be impacted with fæces, is a rational treatment. Thereby the irritant, whatever it may be, is removed, and a better chance for recovery is given. Improper food is so commonly the cause, that the majority of cases are benefited by a preliminary purgation. This it may be necessary to repeat, especially if irritating results follow the nourishment that is given. Probably the best aperient in this case is calomel, in doses of two to four grains, given as powder. This undoubtedly cleans out the upper part of the small intestine, and it will be necessary to follow it up after a few hours with a quickly acting aperient of a saline character, or, better still, senna, if the latter can be borne. If the inflammation be confined to the colon, where, as already said, accumulations of fæces are the common cause, copious simple enemata, repeated every six or eight hours, are of great advantage; and this plan may be pursued in conjunction with the aperient given by the mouth. The object has been to clear out the alimentary canal, and provided that this has been done, abstinence from food for twelve hours, and some bismuth in an effervescing form, are frequently sufficient in milder cases to put the attack on the road to cure. The writer places great reliance on bismuth,

either in the form of solution with an effervescing citrate of potash, and three or four minims of dilute hydrocyanic acid; or granular effervescing lime-juice and bismuth. The nausea or vomiting are best relieved by this treatment. Pain is of course a pressing symptom. Besides external applications of poultices or poppy-head fomentations, the internal administration of opium is very effective—five or ten drops of the tincture every four hours: the opium in these cases does not seem to interfere with the action of the aperients. Should there be peritonitis the opium must be increased in amount, to the end of giving complete rest to the gut. Several leeches applied to the anus, with the view of relieving the hyperæmia of the intestinal tract, are occasionally necessary in extreme cases. When the attack is distinctly attributable to cold, a profuse sweating induced by hot baths, and ten grains of Dover's powder, is often of great benefit. In those cases where, from the duration, character of stools, and previous treatment, there is reason to believe that the irritating causes are got rid of, the diarrhœa may then require special treatment, especially when the patient has been in ill-health, or is constitutionally debilitated, in which cases an ulceration of the bowel is more likely to follow. In such cases a powder, consisting of Dover's powder, 5 grains, and carbonate of bismuth, 10 grains, given every six hours, is very efficacious. Sulphate of copper, nitrate of silver, and vegetable astringents, are frequently used for the same purpose.

So soon as the more acute symptoms have subsided, the bismuth may be still continued and gradually given with a vegetable bitter, such as calumba. But ten to fifteen minims of the dilute hydrochloric acid in an ounce of water is almost an essential to the recovery of the digestive power of the stomach.

In consequence of the great liability to a second attack which this disease engenders, avoidance of well-known harmful articles of diet, and the use of warm clothing or flannel belts, are demanded as a prophylaxis.

In infants and young children the great liability to collapse, often rapidly fatal, must be borne in mind. Stimulants in some form are almost a necessity. The following prescription is usually used by the writer:—Liquoris Bismuthi ♏j-iij, Spiritus Ammoniæ Aromatici ♏ij-v, Tincturæ Cardamomi Compositæ ♏ij-v; Aquæ ʒj-ʒij according to age. Brandy in small quantities is often the means of saving life in these cases. When the collapse is not threatening, two or three drops of solution of corrosive sublimate, with syrup, ʒss. and water, ʒiss., every two or three hours, is of great service. It is a more convenient mode of giving mercury than in the form of grey powder. But in one form or another the writer believes mercury to be of prime necessity. Corrections of diet on the lines indicated above are of course essential. Hot baths and other means to keep the child warm must be followed.

In the severer cases, which are lapsing into the typhoid state, the general principles for that condition must be followed; but, except in such a state, alcoholic stimulants are rarely called for.

(*B*) **Chronic Enteritis.**

Ætiology.—1. A certain proportion of the acute cases lapse into chronic when the original cause persists; or when the structural changes resulting from an acute attack are permanent.

2. Those conditions which lead to a chronic state of congestion of the intestinal tract will thereby so affect the constitution of the tissues, with a consequent disturbance of function, as to constitute a chronic inflammation. The most important of these conditions is obstruction, either at the right side of the heart, or affecting the portal circulation in the liver.

3. Chronic enteritis is the occasional accompaniment of some general chronic disease, such as Bright's disease, when the altered nature of the arterioles, and circulation of a deteriorated blood, may readily be regarded as leading to a chronic inflammation.

4. Residence in tropical climates is a not infrequent cause of inflammatory disease of the bowels.

Anatomical Characters. — The intestinal mucous membrane, when it has been the seat of inflammation for any prolonged time, is thickened, tough, and of a grey or almost black colour, from a deposition of pigment, due to the chronic congestion. The epithelial cells are cloudy and ill-defined, and there is an infiltration of the mucous and submucous layers with new round-celled tissue, passing into the stage of connective tissue; hence the thickness and toughness. The lymphoid follicles are prominent and hard, and the intestinal glands are frequently blocked with cells and secretion, and form minute solid, though perceptible masses. The surface of the membrane will be more or less covered with a viscid glairy mucus, containing pus and imperfectly-formed epithelial cells; not unfrequently such mucus may be voided in the form of complete casts of the tube, and this is particularly the case in the pellicular form of colitis. Sometimes the muscular coat is thickened from connective-tissue formation. As a rule, therefore, the bowel is increased in thickness; but in children it not unfrequently happens that a chronic enteritis is associated with an atrophy of all the coats and the contained glands. It is unusual for a chronic inflammation of the intestine to exist in adults without coincident ulceration; but in children the disease may proceed to a fatal termination, and show no such condition after death.

Symptoms.—Whilst many cases with a persistent cause may be said to be chronic from their outset, it is not always easy to say exactly when an acute case has lapsed into a chronic state, very much the same symptoms being continued. In such affections of the small intestine, the diarrhœa may be wholly wanting, and the bowels may be very confined. This is due to the diminished peristalsis, from œdema of the muscular coat and impaired irritability. When, however, ulceration is extreme, and especially if it be the colon or rectum that is mainly affected, chronic diarrhœa is an invariable symptom. The remarks made on the character of the stools in acute enteritis are equally applicable to the chronic state, with the addition, that solid and liquid evacuations frequently alternate. Lasting

as the disease does often for many months or even years, a general impairment of nutrition results; the function concerned in the elaboration of the food, as well as that by which the digested products are absorbed, are necessarily perverted, from the structural alteration of the organs concerned in their performance; and as a result the entire body suffers. The marasmus is speedily noticed in infants and children, whose growing tissues the less readily withstand malnutrition. Apart from the general ill-health produced, there would seem to be a special inclination for the mental qualities to become affected, so that the intellect may become dulled and sluggish, the temper irritable, and the patient may fall into a condition of marked hypochondriasis; this is particularly liable to be the case when the colon is the seat of the disease. The emaciated appearance; the dirty, muddy complexion; complicated often with a short, dry cough, dependent on reflex causes from the stomach, frequently lead a superficial observer to suspect the existence of phthisis.

Diagnosis.—The grounds on which a diagnosis can be made are sufficiently obvious from a consideration of the foregoing remarks.

Prognosis.—Chronic enteritis almost invariably tends towards a fatal termination, though this may be long delayed. As already said, it is, at least in adults, the colon that is chiefly the seat of this malady, and where it is almost always associated with ulceration, obstinately resisting all treatment, which at best is only palliative; the general nutrition is more and more deranged; and death from inanition finally terminates an existence of prolonged suffering and discomfort.

Treatment.—Owing to the unfavourable tendency of this disease, the treatment can be rarely more than palliative. The debilitating and wearying character of the malady emphatically calls for good feeding. The diet should be abundant, no less than nutritious. When the disease affects the large intestine, the ordinary digestive changes in the food have taken place, and the contents of the canal reach the colon in the normal semi-fluid condition; in this state they may be passed; but owing to the impaired movements of the affected bowel the fæces are apt to accumulate, and constipation results. This should be guarded against by simple enemata, and the soothing effect of injection of warm water only is often very marked. In those cases where the enteritis is a sequence of a congestion of the intestine, the treatment must be directed to relieve if possible the cause of that congestion. Since this is usually some such intractable condition as Bright's disease, cardiac dilatation, or cirrhosis of the liver, it is not very much that can be done.

Tonics—such as quinine, iron, bark, with sea air—are of undoubted benefit; and, so far as possible, causes of mental worry should be removed.

12. Intestines, Malformations of.—These may be (*a*) *congenital*; or (*b*) *acquired*.

(*a*) *Congenital.*—Though seldom of much clinical importance, congenital malformations of the intestines are often of great interest from a developmental point of view. The malformation may be of the nature of an excessive development. Thus certain parts of the canal—duodenum, colon, and appendix vermiformis—have very rarely been found double. The commonest of all these malformations are certain diverticula of the ileum, which may be found protruding from the free margin of the ileum anywhere within ten inches above the ileo-cæcal valve. The cæcal extremities of such processes may be connected with the umbilicus by thin fibrous cords, showing them to be unobliterated portions of the vitelline duct. They vary in length from half an inch to six inches, or even more; their structure is exactly that of the ileum; and they have been found the seat of typhoid ulceration, or of perforation from the irritation of foreign bodies that have become lodged in them. The vermiform appendix may vary from half to twice the natural size.

Deficiencies of development may affect the whole alimentary canal, or only certain parts. Andral records a case where only a straight tube joined the rectum and œsophagus. The ileum may open upon an ectopic bladder. The lower extremity of the canal is frequently imperforate. Thus the rectum may end in a cloaca common to the urino-genital organs; or the bowel may terminate in a closed extremity anywhere between the brim of the pelvis and immediately beneath the skin; the anal pouch, which develops from without inwards, is in the latter case absolutely wanting; and all degrees between this and a pouch that has just failed to establish a junction with the rectum may be met with, producing the lesion known as *imperforate anus*. The valvulæ conniventes are sometimes wanting, or very imperfect, over varying areas of the small intestines. Congenital constrictions of different parts of the canal are occasionally met with—in the duodenum, either close to the opening of the common bile-duct or at the junction with the jejunum; in the lower end of the ileum, where some abnormality in the closure of the vitelline duct appears to be the cause; or in the sigmoid flexure. Such constrictions may be multiple, of very short extent, the canal being much dilated above, and extremely narrowed and shrunken below. The ileo-cæcal orifice has been seen contracted to the diameter of a small cedar pencil. The cause of these lesions is very obscure, but at present they are ascribed to a prenatal peritonitis or enteritis, though they may be occasionally accounted for by the existence of prominent valve-like folds of the mucous membrane.

Hernial protrusions of the mucous membrane through the other coats, often very numerous, and varying in size from a pin to a walnut, have been seen in the colon, sometimes extending into the appendices epiploicæ. They are very liable to become developed in cases of long-standing constipation.

(*b*) *Acquired.*—The acquired malformations include the dilatations and contractions that are associated with stenosis; and the adhesions and abnormal communications established by ulceration and peritonitis, which have been already referred to.

When any symptoms are produced by malformation of the intestines they are usually those of obstruction; and the only condition that may be amenable to treatment is imperforate anus.

13. Intestines, Malignant Disease of.—The new growths which are met with in connection with the intestine may, for the present purpose, most conveniently be divided into *malignant* and *non-malignant*—a clinical distinction irrespective of their minute structure. We will here discuss the former class, in which there are included those neoplasms which tend to produce a fatal result, as a rule, rapidly; and that are accompanied with a marked general perversion of nutrition.

Ætiology.—Malignant growths of the intestine, as in other situations, whilst not wholly unknown in the earlier periods of life, are rarely met with before the age of forty.

From an examination of 9,000 fatal cases of cancer, the relative frequency of intestinal cancer to that of other organs was found to be as 1 to 25 (Tanchou).

Cancer of the intestine is nearly always primary, and very frequently runs its course without any secondary formations elsewhere. Occasionally the bowels are affected by extension from neighbouring parts, and this is especially liable to be the case in the rectum, when the uterus or vagina are the seat of the disease, and in the duodenum, which may become involved in an extension from the pancreas, liver, or stomach. Primary cancer of the duodenum is very uncommon. Very rarely small nodules are found in the solitary and agminated glands secondary to carcinoma existing elsewhere.

Anatomical Characters.—Malignant disease may occur at any spot throughout the entire length of both small and large intestine, but is infinitely more often to be met with at certain special parts, notably the rectum, sigmoid flexure, cæcum, colon generally, and duodenum; the jejunum and ileum being rarely affected. There is undoubtedly a predilection for those spots where any delay may occur in the passage of the intestinal contents, such as the flexures of the large intestine; and this favours the idea that mechanical irritation is largely concerned in the causation of malignant growths.

The greater number of the growths included in the category of malignant are comprised in the group of carcinomata, and present the following varieties:—Schirrus, encephaloid, scirrho-encephaloid, and colloid. Others belong to the epitheliomata, and not a few to the adenomata and lymphadenomata. The former are perverted growths of the epithelial tissue; but sometimes tumours of the sarcomatous or connective-tissue type are met with, following a malignant course, and presenting many points of similarity to encephaloid. The microscopic characters of these new growths present no special features. *See* Cancer; and Tumours.

As a rule, malignant growths would appear to commence in the mucous and submucous coats of the bowel, and then gradually involve the other tissues; but the colloid form usually begins in the peritoneum, and extends inwards.

The mesenteric glands are invariably affected, and may come to form large tumours.

Following the general course of these neoplasms when found elsewhere, they may undergo degeneration and ulceration, thus suffering a diminution in bulk at one spot whilst they extend in other directions, and this is especially the case in the more rapidly growing varieties, as the encephaloid, adenoid, and malignant sarcomata. In the course of their development they may set up adhesions between the bowel and other parts, as the abdominal wall or uterus, and two or more coils of intestine may be thus involved.

The new-formed tissue may constitute an irregular mass of a very variable size and extent, of a nodulated or of a villous appearance, perhaps partially ulcerated, and extending into the passage of the canal, producing an obstruction. The scirrhus and encephaloid growths are liable to develop in an annular manner, involving the whole circumference of the bowel; the obstruction produced in such circumstances may be extreme, even to narrowing the lumen of the tube to barely the size of a probe. Occasionally, however, annular encephaloid growths occur with no stenosis, but rather a dilatation of the canal. The extent of obstruction may be altered by partial destruction of the new growth by sloughing, though the subsequent cicatrices that may result will again constrict the gut.

Symptoms.—For a varying time before this disease definitely and unmistakably asserts itself, the patient complains of vague dyspeptic symptoms; a sense of uneasiness in the abdomen, not amounting to pain, and usually increased after meals; and marked irregularity in the action of the bowels, with or without flatulent distension. The persistent and gradual increase of these symptoms, especially if there be any loss of flesh, is very significant, and should excite suspicion.

Sooner or later, according to the duration of the case, the usual cachexia is established; and in the greater number of cases the patient rapidly emaciates, especially towards the end, though in cases of very short duration the wasting may not be so excessive. The emaciation depends not only on the general perversion of nutrition caused by the development of the cancer, but also on the direct influence it exerts on organs concerned in the digestion of nutriment.

The local signs and symptoms referable to the new growth itself are very variable in their occurrence, and often are singularly slight in comparison with the gravity of the cause. Thus pain may be completely wanting, and perhaps there is but little tenderness on pressure; when present the pain is usually of a dull character, and quite localised. When the rectum is affected, the pain is apt to be rather of a burning character, and to radiate into neighbouring parts; not infrequently in this situation the pain may be extreme, and with tenesmus may amount to a degree of suffering which is very rarely the case elsewhere.

The indications of the tumour produced by the new growth are very uncertain, being often little more than an ill-defined fulness in one region; at other times presenting a distinct hard irregular mass, of variable size, this last quality being partly dependent on fæces. Should the growth happen to be situated on the aorta or iliac arteries, an indistinct pulsation may be communicated to it. The percussion-note over the tumour is usually imperfectly tympanitic, from the existence of coils of intestines between it and the abdominal wall, the thickness of which will of necessity considerably modify the signs of the existence of

the growth. The mass may present all degrees from free mobility to complete fixity, dependent on the nature of its seat, and also on the existence of adhesions to neighbouring parts.

Symptoms of intestinal obstruction are rarely wanting; though, as already said, in exceptional cases the bowels may be dilated at the seat of the growth. Vomiting, constipation of increasing severity, with signs of intestinal distension above the lesion, are among the most constant; occasional diarrhœa, determined by the chronic enteritis which exists, may alternate with the constipation; and rupture of the intestines has been met with. *See* INTESTINAL OBSTRUCTION.

The stools are usually characteristic of the obstruction, consisting of small separate masses, frequently hard and round, and often mixed with sloughed-off portions of the new-growth, or with blood that has escaped from the ulcerated surface. The nearer to the anus the growth is situated, the less change will there be in the blood, which sometimes may be considerable in amount.

If the peritoneum be involved, peritonitis is likely to arise; and ascites, often considerable, is usually developed with colloid cancer. Superadded to these symptoms will be those caused by the morbid condition of any other organ that may be affected, such as the liver, bladder, or uterus.

COURSE AND TERMINATIONS.—Malignant disease of the intestines in the majority of cases progresses continuously from its commencement to a fatal ending. It is difficult to state even an average duration, owing to the insidious onset and vagueness of the first symptoms; but the greater number of cases rarely go beyond twelve to eighteen months from the time when the disease is clearly established, whilst some may be fatal in a few weeks, and a few may last for years.

Death may result as the direct consequence of the cachexia; or from hæmorrhage, peritonitis, or other effects of the growth.

DIAGNOSIS.—An exact diagnosis is often not to be made, and the nature of the case remains throughout uncertain, if not actually as to the existence of a malignant growth, at least as to the seat of it. The insidious and ill-defined character of the earliest symptoms presents nothing diagnostic, though their progressive character and resistance to treatment would cause a suspicion, especially in a person over middle age, and in whom a gradual even though slight loss of weight is noticed. Even in the later stages, the symptoms are almost identical with those of chronic enteritis, which really co-exists with the new-growth to a greater or less extent; and in the not unfrequent cases in which a tumour is not to be felt, or is uncertain in its indications, the diagnosis becomes extremely difficult. Some cases also in which the new-growth is unrecognisable to palpation, and at the same time causes little or no obstruction, closely simulate in their course diseases of the supra-renal capsule; for the latter are not invariably accompanied by cutaneous pigmentation, and the rapid and progressive emaciation, with more or less persistent vomiting, may be common to both. It is true that the malignant cachexia is frequently productive of a characteristic *facies*, but this would equally occur in cancer of the capsules.

Supposing that the existence of an abdominal tumour be clearly ascertained, it is not always easy to determine its connection with the intestine, since the variability in position, in mobility, and in size (due to the accumulation, or the reverse, of fæces), precludes any diagnostic sign, although this very variability is regarded by some as almost indicative of intestinal cancer. In distinguishing between an intestinal tumour and one connected with the liver, pancreas, kidney, mesenteric glands, uterus, abdominal wall, or the inflammatory new-growths following a perityphlitis, an aneurism, or a simple fæcal accumulation, the history of the case, age, progressive nature of the condition, existence of tumour, signs of obstruction, and character of the stools, are the points to be considered in forming a diagnosis. Any one or even two of these points might equally indicate other lesions, but taken collectively, they will usually justify the formation of an opinion. A rectal cancer, that is accessible to the touch or even to inspection, need offer no difficulty, but it is otherwise where it comes to distinguishing a duodenal growth from one strictly limited to the pylorus. The vomiting in the latter case is more persistent than in the former, and there is a greater liability to hæmatemesis; but these are most uncertain signs, as also is the existence of jaundice, which oftener complicates the duodenal affection, from the greater chance of involving or pressing on the bile-duct; but jaundice is not a necessary accompaniment. A firm epigastric tumour, felt close to the margin of the thorax, and associated with distinct dyspeptic symptoms, may also be due to primary cancer of the head of the pancreas. The symptoms of obstruction are less marked at first, but the growth will probably involve the gut in its progress, and cause more complete stenosis. Owing to the destruction of the gland-tissue, the pancreatic juice is not secreted, and undigested fat may be found in the stools.

Similar difficulties may surround the investigation of a tumour situated in the right iliac fossa. Emaciation, constipation, and melæna might equally indicate a scirrho-encephaloid tumour of the cæcum, or the remains of a chronic perityphlitis. The history may help a little, but frequently the case remains throughout in doubt.

TREATMENT.—The extremely rare cases of reputed natural cure of malignant disease of the intestines, brought about by sloughing of the growth and subsequent cicatrisation of its site, afford no hope of our being able to artificially imitate the process, and the treatment remains at the best symptomatic and palliative.

The diet should be so arranged as to contain the minimum of indigestible residue, and permit the chief digestion and absorption in the stomach, if it be the upper part of the tube that is affected. But in the majority of such cases the utmost disinclination for food exists, even apart from any vomiting or pain its ingestion may produce, and hence, whatever the directions, the patient in the later stages practically takes nothing. The anorexia is frequently as marked even when the mischief is seated in the colon, and the area for digestion and absorption is uninterfered with.

In the earlier stages it may be advisable to insist upon as much nutritious food as possible by the mouth or in the form of enema, so as to offer the most prolonged resistance to the inevitable end; but at the same time there is no slight cause for thinking that the same course favours the speedier development of the new-growth. Preparations of iron may be given with the same view.

The symptoms dependent upon the obstruction we can do next to nothing to relieve; only the mildest aperients are permissible, to combat the constipation; while the vomiting is as a rule uncontrollable, and, indeed, is often a relief.

Hæmorrhage may require special attention, and the pain may be so severe as to necessitate free administration of morphia subcutaneously; in other cases belladonna is of value in alleviating the local discomfort, and acts favourably by allaying any spasm. But our best remedies offer no resistance to the progress of the disease, and but too often very little relief.

The special characteristics of cancer of the rectum, sigmoid flexure, or cæcum occasionally permit of operative interference—such as colotomy. *See* INTESTINAL OBSTRUCTION; and RECTUM, Diseases of.

14. Intestines, Malpositions of. — Displacements of the intestines, like malformations, are both *congenital* and *acquired*.

Among the former may be mentioned complete transposition of the viscera, the cæcum and ascending colon being on the left side, and the sigmoid flexure and descending colon on the right, the liver, spleen, stomach, &c., sharing in the change. Certain parts only of the intestinal canal may occupy an abnormal situation, as seen in the various congenital herniæ; or the displacement may be due to unusual length of the mesenteries, the cæcum and sigmoid flexure being the parts that present the most usual alteration from this cause. Thus the cæcum may occupy the left hypochondrium or left iliac fossa, or be found in the pelvic cavity, and, of course, other parts of the canal must correspond to these malpositions. The sigmoid flexure has been seen lying to the right side of the left kidney, which was situated immediately below the bifurcation of the aorta. Similar displacements are referable to adhesions, determined by intra-uterine peritonitis, which is frequently associated with syphilis.

The malpositions which the intestines may come to present from changes set up after birth are so variable as scarcely to admit of classification. Hernia, both external and internal, volvulus, and intussusception are among the well-recognised displacements; but there is scarcely any limit to the changes in position which the traction and pressure of tumours and the effects of peritonitis may produce.

Many of these conditions give rise to no symptoms, and may even fail to be recognised during life. The acquired malpositions lead to obstruction in varying degrees. *See* INTESTINAL OBSTRUCTION; and HERNIA.

15. Intestines, Morbid Growths of. — Owing to the variety of tissues that enter into the formation of the intestine, no less than to the origin of these tissues from two of the three primary layers of the blastoderm, the new-growths that may develop are exceedingly numerous.

It will be most convenient here to consider them from their clinical rather than from their genetic or histological point of view, and to divide them into *malignant* and *non-malignant* growths. The former have already been treated of, and the special neoplasms of tubercular and syphilitic origin are more conveniently referred to separately.

VARIETIES.—1. *Fibromata.* These growths, which are developed from the connective tissue of the submucous coat, are usually of small size, frequently pedunculated, though sometimes appearing as sessile, flattened nodules, of half the size of a pea projecting into the canal. The smaller ones may be scattered throughout the length of the bowel, whilst the larger ones (up to the size of a walnut) are fewer in number or single, and are usually found in the rectum. They present the ordinary microscopic characters of fibrous tissue.

2. *Lipomata.*—Polypoid growths of adipose tissue, springing from the submucous coat, are not of uncommon occurrence in any part of the intestines. Less often they are sessile and of small size.

3. *Myomata.*—Very rarely small growths are met with, chiefly composed of contractile fibre-cells, with a variable amount of connective tissue.

4. *Vascular tumours—Angiomata.* — Besides hæmorrhoids, other vascular growths are sometimes found, of an erectile character, similar to nævi of the skin.

5. *Mucous.*—It is to these growths that the term *polypi* is oftenest applied. They essentially consist of all the tissues of the mucous membrane, though differing in their vascularity, and also in their glandular elements. When these latter are excessive in amount, they are liable to present characters which connect them with malignant forms of new-growth, especially if their surface assume a villous character. Polypi are not limited to any one part of the canal, though undoubtedly they are most common in the rectum. Sometimes they are distinctively pigmented. They are occasionally multiple; and have been met with at all ages.

6. *Lymphoid growths — Lymphadenomata.* — Neoplasms whose structures correspond to that of the solitary or agminated glands, or of the lymphoid layer of the submucosa, are met with in association with these normal constituents of the intestinal wall, and quite independently of any leucocythæmia.

7. *Cysts.*—These have been rarely met with, and the contrast to their comparative frequency in the uterine mucous membrane is remarkable. Dr. Dickinson (*Tr. Path. Soc.* vol. xii. p. 138) records the occurrence of a colloid cyst of the size of an orange, between the muscular and mucous coats of the cæcum in a patient aged 75, so placed as to give rise to no obstruction or other symptoms. The contents were gelatinous and oily, and there were no cysts elsewhere.

EFFECTS AND SYMPTOMS. — As a rule, the growths mentioned above present very little interest, unless they be situated just within the

rectum, and accessible to digital examination. They cannot be diagnosed, though they may give rise to certain symptoms, as, for instance, hæmorrhage from the vascular polypi and erectile tumours, or partial obstruction if they attain any size; but such symptoms are not diagnostic. One of their most interesting effects appears to be the liability that the polypoid forms, occurring in the small intestine, have of inducing intussusception, from interfering with the due progress of peristalsis. Prolapse of the rectum is similarly found to be occasionally due to polypi.

Treatment.—No treatment can be attempted, beyond that of the symptoms which may arise; or the removal of growths within reach of the anus.

16. Intestines, Paralysis of. — The peristalsis of the intestinal tube is normally dependent on automatic nerve-impulses, originating in the intrinsic ganglia of the canal, controlled by both reflex and direct impressions from the cerebro-spinal and sympathetic systems, the former acting *viâ* the vagus in an accelerating manner, the latter *viâ* the splanchnics in an inhibitory direction. The integrity of the involuntary muscular fibre is assumed.

Ætiology and Pathology.—A paresis of the intestinal movements may be brought about by (1) causes acting through the *nervous system*; or (2) through imperfection of the *muscular tissue*.

(1) *Nervous.*—Whilst it is possible that the intrinsic ganglia and nerves of the intestinal muscular coat may be the seat of degeneration, no known observations are recorded Certain lesions of the brain are accompanied by symptoms of intestinal paralysis, but with no hitherto recognised regularity, and it is assumed that such lesions act by interfering with the function of the vagi. It is doubtful how far disease of the spinal cord produces actual paralysis of the intestines, though constipation may result, a circumstance that may be explained by assuming an interference with the centre that controls defæcation. *See* Fæces, Retention of.

(2) *Muscular.*—The irritability of the muscular tissue may be much weakened by degeneration (cloudy, fatty, or amyloid). Inflammation of the mucous or serous coat, especially the latter, is liable to determine granular change in the muscular fibres, which, aided by a coexistent œdema, largely impairs the contractile power of the tissue. The irritability is also liable to suffer from the over-stimulation of too powerful and too frequent purgative medicines; and the muscular fibres of a much dilated portion of the bowel are apt to become paralysed from distension and stretching. The general want of tone that the muscular and nervous systems manifest subsequent to debilitating diseases, want of food, hysteria, and other conditions, also finds expression in the alimentary canal, in diminished peristaltic action.

The *modus operandi* of certain astringent drugs upon the bowel is quite unknown, possibly through the nervous system, as appears to be the case with opium, and perhaps by affecting the muscular fibres or nerve-terminals. Lead, which would seem to cause both paralysis and spasm of the muscular coat, may act in this way.

Symptoms.—The prominent symptom of intestinal paralysis is constipation, though other signs of obstruction, such as vomiting, meteorism, &c., may be superadded. *See* Constipation; and Intestinal Obstruction.

Treatment.—As a rule this is directed to the primary cause, but great benefit has undoubtedly followed the special application of electricity to the abdominal parietes. Friction applied on systematic principles is of undoubted service.

17. Intestines, Perforation and Rupture of. — Ætiology.— The causes of perforation or rupture of the intestines may be arranged thus:—1. *External injuries*, such as blows, being run over, &c., though more liable to rupture the solid abdominal viscera, frequently cause the intestines to burst, especially the ileum or jejunum.

2. *Corrosive poisons*, when swallowed in any considerable amount, may destroy not only the walls of the stomach, but also of the upper part of the intestines.

3. *Extreme distension by flatus* above the site of a constriction may cause the bowel to burst.

4. *Ulcerations*, pre-eminently the so-called peptic ulceration, and less commonly typhoid and catarrhal ulceration, are liable to lead to perforation.

5. *Perforations* may be produced *ab extrâ*, by the bursting of abscesses or aneurisms into the canal.

Symptoms.—The most striking symptom which perforation of the bowel presents is collapse, and it is a noticeable fact that rupture of the hollow abdominal viscera is more liable to induce this condition than a similar lesion of such organs as the liver or spleen. The exact explanation of this collapse is not apparent.

Should the patient live twenty-four hours after the establishment of a perforation, signs of peritonitis will assert themselves—severe abdominal pain and tenderness, pyrexia, vomiting, and other symptoms. Supposing that the perforation follow an ulceration in the course of a previously high temperature, such as enteric fever, there will be a sudden and usually considerable fall in the body-heat; this may be the first indication that perforation has taken place.

Perforation or rupture of the intestines usually proves fatal within forty-eight hours of its occurrence, although cases are recorded which have lasted for weeks; very rarely recovery has taken place.

There are no reliable signs whereby rupture of the stomach may be distinguished from that of the intestines, nor is it of any practical importance. But the collapse and fall in temperature, with the history of the case, are quite sufficient to warrant the diagnosis of perforation of some part of the canal.

Treatment.—Rest is of primary importance, both in regard to the whole body, and the bowels themselves. This object is best attained by the free use of opium, commencing with a grain, and repeating it in a few hours until its influence is fully established. It is also desirable to cut off all food, except an occasional teaspoonful of meat essence; to give ice to suck; to administer nutrient enemata, and brandy and ether if the col-

lapse be profound; and to apply warmth to the extremities.

18. Intestines, Spasm of.—The irregular and forcible movements of the bowels, usually accompanied with pain, are known as *colic*. Under ordinary circumstances we are unconscious of the peristaltic action, but when the contractions of the muscular coats become violent, more or less pain is likely to occur.

Ætiology.—The determining causes of intestinal spasm are:—

1. The direct irritation of indigestible ingesta. 2. Exposure to cold. 3. Certain poisons—lead, strychnia, &c.—which probably affect the muscular fibres through the nervous system.

It is difficult to ascertain the exact condition of the contracted bowel, since the appearances seen after death are not an index of what existed during life; but it would seem that the spasm may start from several points in the course of the canal, and, after persisting for a variable time, either yield or travel on as a wave of spasmodic contraction. For how long a portion of bowel may remain contracted is quite conjectural.

Symptoms.—The existence of a painless spasm of the intestines is very doubtful; as a rule it is the pain which indicates this condition, and except the contraction be maintained, no further symptoms may occur. Constipation, vomiting, meteorism, may all be present in varying degrees, dependent upon the extent of obstruction which is produced. Not infrequently fever, collapse, and prostration may co-exist, leading to the belief that a more serious condition is calling for treatment.

The specially painful spasm of the anal sphincters and lower portion of the rectum termed *tenesmus*, is associated with gouty congestion, with ulceration, and with most other lesions in that locality.

Treatment.—The external application of moist heat in the form of poultices or fomentations, preferably of poppy-head or other opiates, is of great value, for relaxing the spasm or removing the pain. Since an irritant is so frequently the cause, an aperient, such as castor oil or calomel, combined with opium, is essential. The collapse may be so severe as to call for energetic stimulation by brandy, ammonia, or ether.

19. Intestines, Syphilitic Disease of.—The intestinal canal is rarely the seat of the specific lesions of syphilis, except at the lower end of the rectum, and margin of the anus. Small gummata have been found in the submucous tissue of various parts of the bowel, but more often the ulcers to which these growths give rise by their degeneration and breaking down; radiating fibrous cicatrices of the mucous membrane have also been seen, produced by these syphilomata. It is doubtful whether there be any specific ulceration of the intestine which is not preceded by gummata, although small ulcers do occur in newborn children, the subjects of congenital syphilis.

Syphilitic ulceration and stricture of the rectum is not of infrequent occurrence. *See* Rectum, Diseases of.

20. Intestines, Tubercular Disease of.—The specific lesions of the tubercular diathesis, namely, grey granulations or miliary tubercles, are of frequent occurrence throughout the intestinal canal. Regarding them as local developments of lymphoid tissue, the opportunity for their formation is most favourable, owing to the extensive distribution of this tissue throughout the submucous coat, and the special aggregations of it which form the solitary and agminated glands. The abundant supply of lymphatic vessels in the thickness of the walls of the canal, and the close connection of the serous surface with the lymphatic system, all predispose to the development and spread of a tubercular growth which may have become established in a subject of the diathesis.

Ætiology.—As a primary growth tubercle very rarely attacks the intestines in adults, though it is of very frequent occurrence in children as part of a general tuberculosis. In adults, on the contrary, tubercular disease of the intestines is very commonly developed secondary to a similar affection of the lungs.

Anatomical Characters.—The submucous layer and the peritoneal coat are the structures in which the tubercle originates; in the former situation it especially favours the ileum and cæcum, although it may develop throughout the entire length of the tube, whilst the peritoneal tubercle is about equally distributed. The mesenteric glands are always considerably involved. The rareness with which the stomach is affected by tubercle is in marked contrast to the frequency of the intestinal lesion.

In extreme cases of tuberculosis in children, death may take place before any changes in the tuberculous formation have taken place, and countless grey granulations, from the size of a pin's head to bodies microscopic, are to be found in the submucosa, and in the solitary and agminated glands. Later on, however, these non-vascular new-growths coalesce, and form distinct masses, which from lack of nutrition undergo caseous degeneration and break down, thus forming the tubercular ulcers. The ulcers tend to spread, and rarely to heal, and whilst they may be at first limited to the glands, they invade the adjacent mucous membrane, especially in a direction round the bowel, their extension being preceded by the development of fresh tubercles, to the progressive formation and destruction of which the spread of the ulcer is really due. Large masses of the mucous surface may be thus destroyed, leaving a ragged, flocculent surface, formed of the muscular fibres, or even of deeper structures, which lesions rarely proceed to perforation into the peritoneal cavity, adhesive peritonitis having established attachments to adjacent parts. The thickened, congested, irregular edges of the ulcers, with miliary tubercles close to the margin, are very distinctive; apart from the granulations, the ulcers themselves are not unlike those of dysenteric origin, or chronic follicular ulceration.

Symptoms.—Until ulceration be established, there will be no symptoms of tubercular disease referable to the intestinal canal, and even when this stage is reached, there is nothing to distinguish it from ulceration due to other causes. There is the same pain and tenderness, often but little marked; usually an obstinate diarrhœa;

characteristic stools with occasional blood; and progressive emaciation. Added to these are the symptoms due to implication of other organs—lungs, brain, &c.—since tubercular ulceration of the bowels scarcely ever occurs alone.

Treatment.—Little can be done for intestinal tuberculosis. The course of the disease is almost invariably to a fatal end, and it is very rare for healing and cicatrisation to take place. The necessity for feeding the patient is almost contra-indicated by the existence of a destroyed digesting and absorbent surface, whereby the food becomes a positive irritant. Such nourishment as is taken should therefore be in the most digestible and concentrated form, that as much as possible may be taken up from the stomach. Starch and opium enemata may do a little to check the diarrhœa, but their efficacy is soon lost. Hæmorrhage, should it set in, is scarcely amenable to treatment, though astringent enemata may be of some use, combined with the internal administration of acetate of lead and opium. No treatment has as yet been effectual in arresting the spread of tubercle, and until that be gained, there is nothing we can do that will permanently benefit the affected intestines; even palliative measures afford but little relief.

21. Intestines, Ulceration of. — Ulceration of the intestinal wall, from one cause or another, is of extremely common occurrence. The morbid processes involved in the production of the ulcers are in all cases essentially the same, namely, a molecular death and disintegration of the tissue, leaving a solution in continuity, of varying extent. The severe disturbance of tissue-nutrition which leads to ulceration, may be one of the later stages of inflammation:—(1), affecting previously healthy tissues; or (2), as a means for the removal of necrosed tissue; or (3), developed in new-growths.

Varieties: 1. *Primary inflammatory ulcers.*—Any enteritis, whether of the mildest character, or of a specific type such as diphtheritic, may lead to ulceration of the bowels. As a rule, the more severe the cause of the inflammation, the greater the liability to this complication; and the same holds in respect of any intestinal catarrh, developed in the course of any serious state, such as typhus fever or Bright's disease. The ulcer may appear either as a small abrasion of the epithelial layer, which gradually extends and deepens until the whole mucous coat is involved; or the first indication may be a thin glairy pellicle, adherent to the mucous membrane, which in time is thrown off, leaving a breach in the subjacent tissue. In other cases the destructive process commences in the thickness of the bowel, either from the rupture of small collections of inflammatory products, resulting from an enteritis, or from inflammation of the follicles. The escape of these products into the tube leaves behind an ulcer.

These lesions may be found anywhere throughout the bowels, although they are much more frequent in the large than in the small intestine, and one form of follicular ulceration, associated with the specific poison of dysentery, is practically limited to the latter situation. At those places where any delay is likely to arise in the passage of the fæces—the cæcum, sigmoid flexure, and rectum—and at those spots which are most prominent, such as the edges of the valvulæ conniventes, and the sacculus of the colon, where an enteritis is most likely to be produced, there will be the probable site of these inflammatory ulcers.

2. *Ulcers resulting from the separation of necrosed tissue.*—The process of molecular disintegration which takes place in the adjacent bodies of living and dead tissue, resulting in the separation of a slough and the leaving of an ulcer, takes place in the intestines as elsewhere. The causes leading to the death of circumscribed areas of tissue are various. Sometimes the vitality of a portion of the mucous membrane is destroyed by degeneration, such as amyloid, and an ulcer marks the spot of the removed patch. More frequently the local death is induced by cessation of blood-flow through a limited area; the cause of this stasis is not very apparent, though believed to be due to emboli. Under such circumstances the solvent power of the digestive juices may be exerted on the non-living tissues, which are thus removed, and an ulcer is left. To such ulcers the term *peptic* has been applied, and identical lesions are met with in the stomach. They almost invariably occur in the first part of the duodenum, above the point of entrance of the alkaline bile and pancreatic juices, although very rarely they have been seen in the jejunum. Ulcers of this character appear to be connected with large superficial burns, but how the relationship is established is not known. It is a singular fact in regard to them, that they are ten times more common in men than in women, which is quite the reverse of what obtains in the stomach, although the relative frequency of gastric and duodenal ulcers is estimated as thirty to one. Both the ileum and colon have been found ulcerated in amyloid degeneration.

3. *Ulceration of new-growths.*—Almost any neoplasm of the intestinal wall may ulcerate, though as a rule the more rapidly developed forms are more liable. Tubercular and typhoid growths primarily connected with the solitary and agminated glands, invariably end in this manner. Syphilitic gummata and malignant growths are especially prone to ulceration.

Characters.—The appearances presented by the various ulcers differ with the cause and the duration.

They may be single, as is generally the case with the duodenal ulcers; or innumerable, as the follicular ulcers of the colon. Typhoid and tubercular ulcers are as a rule multiple, and are most numerous at the lower end of the ileum, where the agminated glands are most abundant. Occasionally large surfaces of the mucous membrane are destroyed, with here and there small isolated spots of the membrane left, due to the spread and coalescence of many separately arising ulcers. In dysentery and chronic tubercular ulceration this is especially liable to happen. Many of the catarrhal and follicular ulcers are extremely small, not more than a line in diameter

The peptic ulcers are distinguished by their very definite, 'clean-punched' appearance; the edges are slightly sloping, and but very little,

if at all, thickened; whilst the mucous membrane immediately adjacent has a perfectly healthy appearance. In most of the other varieties the edges are thickened, irregular, and shaggy, frequently excavated and overhanging the base; the ulcerative process extending beneath the mucous membrane, which gradually dies and sloughs away as its nutrition is cut off. Dependent upon the depth and course of the ulcer will be the nature of its base, which may be formed of the muscular coat, of the peritoneum much thickened, or of adjacent structures with which adhesion has been established, such as the liver or abdominal wall. The floor of the ulcerated tubercular and malignant new-growths usually presents small nodules of the neoplasm, which are being developed coincidently with the ulceration. The buff or ash-grey pigmented sloughs, partially separated, give a characteristic appearance to the old-standing ulcers of dysentery and tubercle. The tubercular and typhoid ulcers of Peyer's patches present a certain difference in the direction in which they extend; whilst at first both are limited to the patch, the former tend to spread in an annular manner, whilst the latter have usually their long axis corresponding to the length of the bowel. This difference depends rather on the duration of the ulcer, than on any specific distinction due to the two diseases; for the more acute enteric lesion rarely spreads much beyond the area of the patch, which is in the long axis of the bowel, whilst the chronic tubercular ulcer follows the distribution of the lymphoid tissue outside the patches, and particularly along the course of the blood-vessels and lymphatics.

Course.—The course of an intestinal ulcer may be acute or chronic, lasting a few days or for years. Some of the simple ulcers of an acute intestinal catarrh belong to the former group; whilst the ulceration that accompanies chronic enteritis may be of indefinite duration.

The acute forms may either heal or go on to perforation; in the former case their existence can only be inferred, and catarrhal and follicular and enteric ulcers belong to this category. The peptic and typhoid ulcers are those most liable to perforate the gut, their duration being too short to allow of the formation of adhesions to neighbouring structures, as is very apt to be the case in the more chronic forms. Occasionally the perforation may lead to communication between one coil of intestine and another, between the duodenum and stomach, or between the bowel and bladder, without any rupture into the peritoneal cavity, which is the commonest end of a perforating typhoid ulcer. In chronic ulcers, where no adhesion or communication takes place, the base is thickened by a new-formed connective tissue, which is developed as fast as or even faster than the destructive process proceeds, and hence the intestinal wall adjacent to, and involved in such ulcers, is usually much thickened and indurated. Short of actual perforation or adhesion to other parts, the site of the ulceration most frequently is marked on the external surface of the bowel by a sub-acute peritonitis, which may produce a partial matting together of the intestines.

In the course of the healing of the larger ulcers, by the formation of a contracting cicatricial tissue, the gut may be considerably constricted, and a most formidable obstruction may be established. But this does not necessarily follow even large ulcers, such as those of typhoid fever; and the extent of depth of the destruction would seem to influence this result; when the superficial portion of the mucous membrane only is destroyed very little contraction follows, but when the deeper parts of the wall are involved the subsequently developed cicatrix tends to shrink considerably. Similar differences are seen in destructions of the skin and subcutaneous tissues.

Symptoms.—The greatest diversity is met with in the symptoms of intestinal ulceration, and few, if any, can be regarded as characteristic. Inasmuch as the lesion may occur without producing any symptoms; or those that do exist may be determined by the course of, or by the conditions associated with the ulceration; or lastly, the results of this condition, such as perforation, may entirely obscure the actual ulceration itself: it frequently happens that the existence of an ulcer is not recognised. Nor may the severity of the symptoms be taken as a measure of the extent of the ulceration, for the most marked pain, tenderness, diarrhœa, and other symptoms may be produced by an area of typhoid ulceration that heals; whilst a perforating duodenal ulcer may give scarcely any indication of its existence, until within a few hours of a fatal ending. This course appears to be very characteristic of duodenal ulcers; and the writer has recorded a case of a young man who was suddenly attacked with all the symptoms of apparently intestinal colic, after constipation of a week's duration, no vomiting and no tenderness, the pain being relieved by pressure on the abdomen. Collapse set in, and death resulted in less than twenty-four hours from the commencement of the attack. The autopsy showed a perforating duodenal ulcer. Such a case is not singular, and may be preceded, as this case was by nothing beyond an occasional feeling of discomfort at the epigastrium, not serious enough to call for advice or treatment.

Such symptoms as diarrhœa, vomiting, pain, tenderness, and pyrexia are as much dependent on a co-existent enteritis or new-growth, as they are upon the ulcer. Doubtless the exposed surface of an ulcer offers the opportunity for increased peristalsis being induced, but this is not of necessity, for constipation may be present. Where the area of ulceration is extensive, the absorbing surface is by so much diminished, and thus while the general nutrition suffers, the unabsorbed products of digestion are liable to decompose and induce diarrhœa. Vomiting may arise from a duodenal ulcer, but not always, and when present it may be due to peritonitis; icterus may also complicate an ulcer in this situation, by involving the opening of the bile-duct, or by extension of the duodenal catarrh. Pain may be quite absent or quite insignificant, unless the rectum be the seat of the disease, when the pain and tenesmus are excruciating.

The passage of blood in the stools, especially if bright, is probably a most characteristic indication of ulceration, but it does not always

occur, and it may be due to general venous congestion from partial obstruction. *See* STOOLS.

The symptoms due to perforation have been already described. *See* INTESTINES, Perforation and Rupture of.

DIAGNOSIS.—From what has been said, the formation of a diagnosis of intestinal ulceration is frequently impossible, and an ulcer is assumed rather than proved to exist. In enteric fever ulceration is taken for granted as existing, though no special symptoms may indicate its presence. But if a severe and persistent diarrhœa, with liquid stools and shreds of mucus, and much pain and tenderness over the abdomen, supervene in a case of tubercular phthisis, it is a fair inference to assume ulceration of the intestines. In dysentery, like enteric fever, the ulceration is a specific part of the disease, and the diarrhœa, pain, and characteristic stools are in this case directly dependent upon the ulceration. Since there are no constant distinctive symptoms of ulceration, the ground for a diagnosis must remain uncertain.

PROGNOSIS.—This largely depends upon the cause. Except through perforation or fatal hæmorrhage by erosion of vessels, death does not take place from the ulceration itself. But a tubercular ulceration is not to be expected to heal, and it may by its development hasten the end of a phthisical patient. The prognosis in typhoid ulceration will almost entirely be founded on the general state of the patient, since the indications of the ulceration itself may be so slight. The ulceration of malignant new-growths may be of actual benefit, by removing portions of the mass, and so diminishing obstruction. In all cases the liability to stenosis must be remembered; and the impaired health of body and mind in chronic ulceration may continue throughout life.

TREATMENT.—Since ulcers of the intestine are inaccessible to direct treatment, little can be done for them apart from the general conditions which they may complicate, or the treatment of the symptoms to which they may give rise.

Recognising that an ulcer, when it exists, may lead to perforation, the object will be to avoid all undue movements of the intestines, and hence aperients are forbidden, and opiates are indicated. The astringents that are likely to be used for the diarrhœa or hæmorrhage may exert a local action on the lesion, and for that purpose bismuth, sulphate of copper, and similar agents, are recommended. But rest is probably the only element of treatment that can affect the ulcerative process directly; whilst any improvement of the general condition will necessarily favour the healing—objects which can be best accomplished by the use of diet of the most bland description, or of nutrient enemata.

In the preceding article the diseases to which the intestines are liable have been treated of as affecting the canal as a whole: but it will be observed that when the structure and functions of particular regions of the bowel modify the character of the disease, special reference is made thereto; and, further, that when the affections of any portion require detailed description—as of the cæcum or rectum, the reader is referred to articles under those headings.

WILLIAM HENRY ALLCHIN.

INTRA-THORACIC TUMOURS.—Under this general term are included all growths and diseases within the chest, which give rise to tumours or swellings, offering more or less mechanical interference with the functions of the thoracic organs, and for the most part manifesting themselves by external swellings. Aneurisms would thus be comprised in this general definition. The general features and pathology of aneurismal tumours are, however, so distinct as to require separate consideration (*see* THORACIC ANEURISM). Other intra-thoracic tumours will be found described under the headings LUNG, Malignant Disease of; and MEDIASTINUM, Diseases of.

J. RISDON BENNETT.

INTUSSUSCEPTION (*intus*, within, and *suscipio*, I receive).—A form of intestinal obstruction, in which one portion of the bowel passes into another portion. *See* INTESTINAL OBSTRUCTION.

INUNCTION (*in*, on, and *unguo*, I anoint). SYNON.: Anointing.—This is a method of applying certain substances to the cutaneous surface, the object being to promote their absorption, either for the purpose of producing local effects, or of influencing the system generally. Inunction implies more or less friction, the substance employed being rubbed with the hand into some part of the skin. When used for local purposes, the part to be anointed must be chosen accordingly; but if it is intended to affect the system, a region must be selected where the cutaneous tissues are thin, such as the inside of the thighs, or the axillæ, so that absorption may take place more rapidly and easily. The rubbing must be carried on gently, and for a variable time according to circumstances; it may be aided by heat, being performed before the fire, or the part may be previously fomented.

APPLICATION AND USES.—The pharmaceutical preparations which are employed for inunction include glycerines, liniments, oils, ointments, oleates, and compounds made with vaseline, ozokerine, and other materials of a like nature recently introduced. If these are used for local purposes, they may be employed simply on account of the oleaginous ingredients, or to allow friction to be more easily carried on; but active ingredients are often combined in the preparations mentioned above, varying according to the object sought to be obtained, such as to produce a stimulant or an anodyne effect. Inunction for procuring absorption in order to affect the system, is almost entirely confined to the use of mercury, and on this subject the following observations were written for this work by the late Mr. Gascoyen:—

'Inunction is an old but very effectual plan of introducing mercury into the system by the skin. Although objected to as a dirty method, and therefore less practised than fumigation, it is often much more convenient, and can be used in many cases where the mercurial bath is impracticable.

'From half a drachm to one drachm of strong mercurial ointment, mixed with an equal quantity of lard, should be rubbed into the skin on the inside of the thighs, legs, and arms, before a fire at bedtime, using the different limbs on successive nights. The friction should be gentle

and continued for a quarter of an hour to half an hour, when most of the ointment will have disappeared; the surface must not be washed, and the patient should wear the same flannel under-clothing night and day. The ointment may be used every night until the gums give evidence of its action, when the quantity and frequency of application must be diminished. Sometimes it will produce an irritation of the skin, especially in fair or hairy persons. If this occur, the surface must be washed clean, and the rubbing discontinued.

'Inunction is a most convenient way of treating syphilis in young children. The ointment should be spread upon a flannel roller, and the body of the child swathed therein; occasionally the skin should be washed, and fresh ointment applied.

'Although but little practised now in this country, inunction is still largely employed on the Continent, and particularly in conjunction with the natural sulphur waters, for cases of old-standing syphilis.' FREDERICK T. ROBERTS.

INVAGINATION (*in*, in, and *vagina*, a sheath).—A synonym for intussusception. *See* INTUSSUSCEPTION; and INTESTINAL OBSTRUCTION.

INVASION, Modes of.—This expression signifies the manner in which a disease sets in or commences, and the mode of onset of an illness is frequently an important factor in forming a diagnosis as to the nature of the complaint. The following are the variations noticed in this respect:—1. The invasion may be absolutely or almost *sudden*, although slight symptoms may have been previously observed, indicating the presence of some morbid condition, but not sufficiently marked to attract attention. Or there may be distinct indications of some disease, but a secondary lesion suddenly occurs in its course. This mode of onset is exemplified by the immediate effects of injuries, apoplexy, syncope, rupture of the heart, cholera, many cases of hæmorrhage, and most forms of colic. Certain diseases of a paroxysmal type are also characterised by the occurrence of attacks, which come on more or less suddenly, such as asthma, ague, and epilepsy. Some cases of fevers, especially typhus and relapsing fever, as well as of inflammatory diseases, begin in a sudden manner. 2. Frequently the onset is *acute*, the symptoms coming on rapidly, and becoming speedily severe, though often preceded for a variable time by premonitory symptoms. This is illustrated by most cases of the various fevers, and the different forms of acute inflammation. 3. A *subacute* mode of invasion is not uncommonly noticed, this being less rapid, and the symptoms less marked than where it is acute. 4. Most affections are *chronic* in their onset, setting in gradually, and often imperceptibly, so that it may be a long time before the patient is aware that there is any deviation from health. FREDERICK T. ROBERTS.

IODISM.—DEFINITION.—Iodism is the term within which we include a variety of painful and inconvenient effects, following, under certain rare circumstances, the administration of iodine and its salts, but more especially the iodide of potassium.

DESCRIPTION.—Iodide of potassium being in part, at least, decomposed in the presence of ozone by the acids of the blood, we shall endeavour, in considering the symptoms of iodism, to determine which are due to the iodine, and for which the potash must be held responsible. The physiological action of iodine is mainly directed to the nutritive and glandular functions, to the skin and mucous membranes; whilst the salts of potash are not only diuretic and purgative, but, experimentally at least, powerfully depress the heart and spinal cord.

Rilliet, the most exhaustive writer on the subject, makes three forms of iodic intoxication: the first consisting of gastric irritation; the second, where nervous troubles come into more special prominence; whilst cachexia and rapid emaciation characterise the third. But the most orderly and convenient plan to pursue, will be to take into consideration, in regular order, the effects produced by iodine salts on the various organs and functions of the body, under various conditions of idiosyncrasy or retarded elimination.

1. *On the nervous system.*—Mental depression and diminution of muscular energy are not infrequently noted in patients taking iodide of potassium; whilst neuralgia, tinnitus aurium, and convulsive movements have also been described. It is probable that the potash is here the active agent.

2. *On mucous membranes.*—Much mucous irritation is occasionally observed; conjunctivitis, lachrymation, sneezing and running from the nose, frontal headache, and puffy swelling of the eyelids, closely simulating coryza, being the most common symptoms of iodism, and sometimes following a single small or moderate dose. Pharyngeal congestion, and irritable redness of gums and tongue, have also been described. These symptoms are doubtless due to the iodine.

3. *On the skin.*—The eruptions produced by iodide of potassium have recently attracted much attention, and they appear under several forms. Erythema has been observed; and most practitioners of experience must have seen the small round petechial spots, situated between the knees and ankles. These do not as a rule cause any inconvenience, and are usually accidentally discovered; but Dr. Stephen Mackenzie records the case of an infant of five months old, suffering from hereditary syphilis, who died of purpura after taking two and a half grains of iodide of potassium in a single dose. Some further points of interest, in connection with a case of this kind, reported by Dr. G. F. Duffey, will be found in the *British Medical Journal*, 1880, vol. i. p. 626.

A papular and pustular eruption resembling acne, and occasionally appearing in so great profusion as to excite the suspicion of small-pox, is not very uncommon. The late Dr. Tilbury Fox has noted 'a quasi-bullous disease,' summing up the description of his cases as follows: 'In some parts they resembled acne simplex; in others they vesiculated and subsequently simulated variolous pustules; at a later stage ecthyma; finally bullæ filled with milky contents, or discharging smegma; and these bullæ possessed peculiar solid bases wholly unlike true bullæ,

and answering rather to large molluscum contagiosum tumours with semi-fluid instead of more solid contents.'

Dr. Fox believed this condition to be essentially distinct from hydroa, but Mr. Hutchinson has brought forward good evidence to show that the rare skin-affection going under that name must usually be looked upon as one of the symptoms of iodism. The same author mentions a case of deep and unhealthy ulceration of the legs following the prolonged use of iodide of potassium. It seems probable that the iodine rather than the potash must be held responsible for these symptoms. See *Archives of Dermatology*, 1880.

4. *On the nutritive and glandular systems.*—Patients taking iodide of potassium sometimes complain of nausea, anorexia, and a bitter taste in the mouth; but where cachectic symptoms supervene, indicated by rapid emaciation, nervous palpitation, insommia, and hypochondriasis, a ravenous desire for food has been observed. Vomiting, diarrhœa, and diuresis have also been described. Salivation is not an uncommon symptom. A time-honoured accusation against iodine is its supposed tendency to cause atrophy of the mammæ and testicles; of this, fortunately, there is no real proof, the disappearance of the testicle, which occasionally accompanies the absorption of inflammatory products in its substance, being sometimes unjustly attributed to the treatment pursued.

Pathology.—The only reason for the occurrence of many cases of iodism seems to be an individual peculiarity on the part of the patient, or in other words, that idiosyncrasy which so frequently interferes with our efforts for the treatment of disease. But now and then a more plausible explanation may be given, when we find cardiac or renal disease coinciding with the pustular rash of iodide of potassium. Retarded capillary circulation would naturally detain the drug within the blood; whilst the blocking of its usual means of exit from the system might be supposed to throw the onus of elimination on the glandular structures of the skin. Hence has been derived the plausible theory that iodine-acne is produced by direct local stimulation of the sebaceous structures; but, however true this may be in the slighter cases, Dr. Thin's careful examination of the skin of a patient suffering from a bullous rash, has shown the true pathological condition to be one of rupture of blood-vessels at certain localised points, with blocking by coagula, and escape of some of the constituents of the blood into the surrounding tissues. The sebaceous elements and sweat-glands were quite unaffected, and he believes the iodic papule, the so-called acne, the bulla, and the purpuric spot, to represent different stages of vascular injury. Drs. Duckworth and Vincent-Harris were unable in their observations to detect any rupture of vessels, but confirm Dr. Thin's report in all other essential respects.

Diagnosis. — Coryza, or any skin-eruption, suddenly occurring in a patient taking iodide of potassium, ought to be looked upon with suspicion, and treated by the immediate suspension of the drug. The slighter varieties of iodism are by no means uncommon, and may appear after a single small dose; but although ammonia has been confidently vaunted as a specific against such irregular manifestations of physiological activity, experience has been unable to confirm this, and we should place more faith in encouraging prompt elimination by very free dilution of the remedy.

Fortunately, the graver symptoms of iodism are decidedly rare, and we may all the more congratulate ourselves on this, when we remember how powerless we are to recognise the idiosyncrasy on which they depend. Trousseau, however, pointed out that iodine is always badly borne in exophthalmic goître; and Dr. Stephen Mackenzie is inclined to credit syphilis with some share in producing the purpura which proved fatal to his patient.

Robert Farquharson.

IRELAND, South of. *See* Queenstown. Glengariff is also deserving of notice.

IRITIS.—Inflammation of the iris. *See* Eye and its Appendages, Diseases of.

IRREGULAR.—This term is applied to cases of disease which do not run their regular or typical course, such as gout (*see* Gout); or to functions when they are disturbed with respect to time or rhythm—as the pulse, the bowels, or menstruation.

IRRIGATION (*irrigo*, I water).—A method of applying cold water as a therapeutical agent, which consists in causing it to fall drop by drop on one spot. *See* Cold, Therapeutics of.

IRRITABILITY (*irrito*, I provoke).—In physiology this word signifies the power of responding to a stimulus, as exemplified by the contractility of muscular tissue. In medicine irritability implies an undue excitability of an organ or tissue, from disease or disorder, such as of the brain, spinal cord, stomach, eye, or bladder.

IRRITATIVE FEVER. — The nervous disturbance consequent upon fretting of the system by various sources of irritation, gives rise to a pyrexia which is often called 'Irritative fever.' The febrile excitement so familiar to the surgeon as a consequence of wounds and injuries may be classed under this head. It may, however, be provoked by any kind of irritation, especially irritation applied to the mucous membrane of the alimentary canal. The rise of temperature which often accompanies irritation of the bowels by scybalæ or acrid secretions, and the febrile phenomena attendant upon dentition, may be quoted as familiar examples of irritative fever which must be within the experience of all.

The readiness with which pyrexia can be induced by these and similar causes must vary according to the intensity of the irritant, and the constitutional peculiarities of the individual upon whom it operates. As a rule, men are less susceptible than women, and women than children. In children, indeed, with their exalted nervous sensibility, feverishness from this cause is a common symptom. In young subjects mental emotion alone will often produce a rise of temperature, which may be a source of perplexity. In children's hospitals it is a common

observation that the bodily temperature on the night of admission is high, even although the illness affecting the child is one not in itself usually accompanied by fever.

Dentition in young children is so frequent a cause of pyrexia, that the state of the gums should never be overlooked in any case where feverishness is a prominent symptom. Neglect of this precaution may cause some obscurity in the diagnosis. Thus, if a child, while cutting a tooth, have an attack of pulmonary catarrh, the temperature will almost certainly be high. In such a case the cough, combined with fever, rapid breathing, and a quick pulse, might naturally suggest the presence of pneumonia. On examination, however, it will be found that the pulse-respiration ratio is little perverted, the cough is loose and not hacking, and the history of the attack is not the history of pneumonia. On searching further for a cause of the pyrexia, tension and swelling of the gums will be noticed, and the difficulty will be at once explained.

Irritation of the stomach and bowels by acrid secretions or indigestible food is another common cause of irritative fever in children. The intense nervous disturbance excited in young babies by an improper meal induces a rapid rise of temperature, and may culminate in an attack of convulsions. Fæcal accumulation, or the irritation of worms in the bowels, may also, in children and delicate women, produce sufficient disturbance to give rise to fever.

In children the sensitiveness of the system to irritants varies according to the age of the child, according to the natural impressionability of its nervous system, and also according to the state of its general health. Thus, as a rule, the younger the child, the more sensitive is its nervous system; but even in young babies differences will be found in this respect, some being affected much less easily than others by reflex stimuli. In all, however, slow reduction of the strength, such as is produced by progressive chronic disease, gradually reduces nervous sensibility; and a child, enfeebled by an illness of long standing, may show a complete insensibility to all nervous impressions. In young subjects irritative fever, like other forms of pyrexia, is usually remittent; but its remissions are not always found at the same period of the twenty-four hours. There is not, for instance, always a fall of temperature in the morning and a rise at night. One of the peculiarities of this form of febrile disturbance is the irregularity of the fever. A high morning temperature in a young child should always suggest a reflex cause for the pyrexia.

Treatment.—The treatment of irritative fever must be directed to the relief or to the removal of the irritating source from which the fever proceeds. The use of febrifuge remedies may be also called for, if constitutional symptoms be marked or persistent. Eustace Smith.

ISCHÆMIA (ἴσχω, I restrain, and αἷμα, the blood).—Deficiency of blood in a part, short of complete cessation of the circulation: partial anæmia. *See* Circulation, Disorders of.

ISCHIALGIA (ἰσχίον, the haunch, and ἄλγος, pain).—A synonym for sciatica. *See* Sciatica.

ISCHL, in the Saltzkammergut, Austria. A sheltered, bracing, mild, rather moist climate. Altitude 1,560 feet. Thermal common saline baths. *See* Climate, Treatment of Disease by; and Mineral Waters.

ISCHURIA (ἴσχω, I restrain, and οὖρον, the urine).—This word properly signifies the arrest of the secretion of urine (*see* Urine, Suppression of). It is also applied to mere retention of urine.

ISSUES. *See* Counter-irritation.

ITALY. *See* Climate, Treatment of Disease by; and Naples, Pisa, Rome, and San Remo.

ITCH. A popular name for scabies. *See* Scabies.

ITCHING. *See* Pruritus.

-ITIS. A terminal syllable used to indicate an inflammatory disease of a tissue, or organ; for example, Pleuritis, Hepatitis, or Cystitis.

J

JACTATION, or JACTITATION (*jactatio*, a tossing about of the body, or marked restlessness).—This is a condition mostly associated with certain severe febrile diseases, but also with some nervous affections, with severe pericarditis, or as a sequence of copious uterine or other hæmorrhages. A restlessness amounting to jactation may likewise be met with in some patients, when suffering from severe or long-continued pain. It must not be confounded with certain forms of chorea, in which a somewhat similar tossing about of the body may be encountered. The absence of pain and of marked febrile disturbance, together with the history of the patient, will, even in the cases where the general resemblance is closest, speedily enable the latter condition to be recognised.

JAUNDICE.—Synon.: Icterus; *Morbus regius*; *Morbus arquatus* (Celsus); Fr. *Ictère*; *Jaunisse*; Ger. *Gelbsucht*.

Definition.—Jaundice may be defined as a yellowness of the integuments and conjunctivæ, and of the tissues and secretions generally, from impregnation with bile-pigment.

Ætiology and Pathology.—All cases of

jaundice may be referred to one of two classes:—

1. Cases in which there is a mechanical impediment to the flow of bile into the duodenum, and where the bile is in consequence retained in the biliary passages, and thence absorbed into the blood.

2. Cases in which there is no impediment to the flow of bile from the liver into the bowel.

These two forms of jaundice have long been recognised; but there is much difference of opinion as to the mode of production of the jaundice in the second class of cases, although these are, perhaps, the most common in practice.

When there is any obstruction to the flow of bile through the hepatic or common duct, the way in which jaundice arises is sufficiently clear. The bile-ducts and the gall-bladder become distended with bile, which is absorbed into the blood by the lymphatics and the veins. If the hepatic duct of a dog be ligatured, and the animal killed after two hours, the lymphatics in the walls of the bile-ducts are seen to be distended with yellow fluid; the fluid in the thoracic duct is also yellow, and so likewise are the intervening lymphatic glands. In patients also who die of obstruction of the bile-duct, the lymphatics of the liver are often found to contain bile. On the other hand, two hours after ligature of the common duct, the serum of blood taken from the hepatic vein contains much more bile-pigment than that of blood taken from the jugular vein, which shows that in cases of obstruction of the bile-duct, bile is also directly absorbed by the veins.

But in a large proportion of cases there is no mechanical impediment to the escape of bile from the liver, and then an explanation of the jaundice is less obvious. Boerhaave and Morgagni long ago suggested that the jaundice in these cases was the result of a *suspended secretion*. They taught that the function of the liver was merely to separate the elements of bile which were already formed in the blood, and that when anything interfered with the function of the liver, the elements of bile accumulated in the blood, and the result was jaundice of the skin and other tissues. Although this view has been strenuously opposed by several excellent authorities, it is, in this country at all events, still generally accepted. It is advocated, for example, by Dr. George Budd, in his valuable treatise on diseases of the liver, although it is but right to add that Dr. Budd makes a special exception with regard to the biliary acids. 'The most skilful chemists,' he says, 'who have recently analysed the portal blood, have failed to detect the biliary acids in it, and have come to the conclusion that these at least are formed in the liver.' This opinion, that the liver manufactures the bile-acids, while it merely excretes the bile-pigment, was adopted by Dr. G. Harley, in his essay on jaundice.

There are, however, weighty objections to this view, some of which may be mentioned.

1. Although bile-pigment appears to be derived from the colouring matter of the blood, it has not yet been satisfactorily shown that bile-pigment, as such, exists ready formed in the blood of persons who have not jaundice. Frerichs denies that it ever has. Lehmann, who has investigated with great care the changes which the blood undergoes in passing through the liver, has never been able to detect the colouring matter of bile in portal blood, and infers that this, as well as the bile-acids, must be formed in the liver itself. The blood of the hepatic artery has been examined with a like result. It is obvious that if bile-pigment exists in healthy blood at all, its quantity must be very minute; and when we consider that the quantity of bile secreted by the human liver daily is about two pints, and yet that jaundice is not a normal condition, it seems impossible that all the bile-pigment secreted by the liver can be formed in the blood, and it is not probable that part is formed in the blood and part in the liver. The discovery by a few observers of a small quantity of bile-pigment in what appeared normal blood does not prove that it was formed in the blood. It is quite conceivable that it may have been formed in the liver, and have become subsequently absorbed.

2. The secreting tissue of the liver is often for the most part or entirely destroyed, so that bile is no longer secreted, and yet no jaundice results. If bile-pigment be formed in the circulating blood, it is difficult to explain what becomes of it in these cases.

3. If the constituents of bile are formed in the blood, intense jaundice ought at once to follow the extirpation of the liver in any of the lower animals, in like manner as urea accumulates in the blood after removal of the kidneys. But Müller, Kunde, Lehmann, and Moleschott have repeatedly extirpated the liver of frogs, and have invariably failed to find a trace of the biliary acids, or of bile-pigment, in the blood, the urine, or the muscular tissue.

These and other considerations make it very doubtful if any case of jaundice can with propriety be attributed to a suppression of the hepatic functions; and it is therefore necessary to seek for some other explanation of those cases of jaundice in which there is no obstruction in the bile-duct.

A solution of the difficulty has been proposed by Professor Frerichs, of Berlin. According to this distinguished observer, a large proportion of the colourless bile-acids found in the liver is either directly taken up by the blood in the hepatic vein, or is absorbed from the bowel. Under ordinary circumstances, these bile-acids become oxydised and assist in forming the large quantity of taurin found in healthy lung, and the pigments voided in the urine; but if these normal metamorphoses are interrupted by nervous agencies, or by poisons in the blood, the bile-acids, not being sufficiently oxydised, are converted into bile-pigment in the blood, and the result is jaundice. This view has been supported by two experiments intended to show:—first, that bile-pigment can be produced artificially from the bile-acids, by the action of concentrated sulphuric acid; and, secondly, that colourless biliary acids, when injected into the veins of dogs, are converted in the blood of these animals into bile-pigment. There is, however far from being unanimity among different observers as to the results of these experiments; and a decision of the points at issue does not appear

to be of material importance for explaining those cases of jaundice in which there is no obstruction of the bile-duct, inasmuch as there are good grounds for believing that not only in jaundice, but in health, a portion of the bile-pigment, as well as of the bile-acids, formed in the liver, is absorbed into the blood.

Although the amount of bile secreted daily must vary in different persons, and in the same person under different circumstances, being modified by the quantity and quality of the food, the activity of respiration, and other conditions, there can be little doubt that but a small portion of that which is ordinarily secreted is discharged from the bowel. Observations on the lower animals and on man himself have shown that the quantity of bile secreted by the liver of a healthy adult averages forty ounces. It is generally admitted that the fæces contain but a fraction of the bile-acids (altered) corresponding to this quantity of bile, and it seems equally clear that much of the bile-pigment must also disappear in the bowel. There are grounds for believing that the bile-pigment which so disappears goes to form urinary pigment; while the fact familiar to all clinical observers, that the bile-pigment discharged from the bowel is greatly increased by calomel and other purgatives, without any corresponding increase of secretion of bile by the liver, seems to show that under ordinary circumstances much of the bile-pigment secreted by the liver is not discharged with the fæces. It may be added that in carnivorous animals and in snakes, although bile-pigment is secreted in abundance by the liver, the quantity discharged with the fæces is even relatively less than in man.

The question as to what becomes of the bile which is not discharged from the bowel has an important bearing on the pathology of the cases of jaundice now under consideration. A large proportion of it is again absorbed, either by the biliary passages, or by the mucous membrane of the bowel. From what is now known of the diffusibility of fluids through animal membranes, it is impossible to conceive bile long in contact with the lining membrane of the gall-bladder, bile-ducts, and intestine, without a large portion of it passing into the circulating blood. The constant secretion and reabsorption of bile is, in fact, merely part of that osmotic circulation constantly taking place between the fluid contents of the bowel and the blood, the existence of which is too little heeded in our pathological speculations and in therapeutics. The quantity of fluid which is being thus constantly poured out from the gastric and intestinal glands, the liver, pancreas, &c., and then reabsorbed is enormous; in twenty-four hours it probably far exceeds the whole amount of blood and fluid in the body. The effect of this continual outpouring is supposed to be to aid metamorphosis; the same substance, more or less changed, seems to be thrown out and reabsorbed, until it is adapted for the repair of tissue or becomes effete. How many times this cycle of movement is repeated, before the bile is extruded from the system, we have no means of knowing; but in the course of this osmotic circulation, much of the bile appears to become transformed into products which are eliminated by the lungs and kidneys, while at the same time this circulation assists in the assimilation of the nutritive materials derived from the food.

Here, then, we have an explanation of those cases of jaundice where there is no impediment to the flow of bile from the liver. Under normal conditions, the whole of the bile that is absorbed is at once transformed, so that neither bile-acids nor bile-pigment can be discovered in the blood or in the urine, and there is no jaundice. But in certain morbid states, the absorbed bile does not undergo the normal metamorphoses; it circulates in the blood and stains the skin and other tissues, and in this way we have jaundice without any obstruction of the bile-duct. The morbid states which, so far as we know, conduce mainly to this result are, for the most part, precisely those in which we might expect abnormal blood-metamorphoses, namely:—

1. Certain poisons, such as those of yellow fever, relapsing fever, pyæmia, and more rarely those of remittent fever, typhus, and scarlatina; also snake-poison, chloroform, &c.

2. Nervous influences, such as a sudden fright, violent rage, great or protracted anxiety, and concussion of the brain.

3. A deficient supply of oxygen, as happens in certain cases of pneumonia, or in persons living in confined and crowded dwellings.

4. An excessive secretion of bile, especially when conjoined with constipation. In this case, unless the bile be removed by purging, the quantity absorbed may be too great to undergo the normal metamorphoses, and the presence in the blood of the untransformed bile causes jaundice.

According to this view, the only pathological difference between jaundice from obstruction and jaundice independent of obstruction of the common bile-duct is that, in the former case, little or none of the bile secreted by the liver can escape from the body with the fæces, and consequently all that is secreted is absorbed into the blood, and the quantity thus absorbed is far too great to undergo the normal metamorphoses; while, in the latter case, bile passes into, and is discharged from the bowel, as usual, but that which is absorbed, which in quantity may not exceed what is absorbed in health, remains unchanged in the blood. As might be expected, the jaundice in the former case is usually much more intense than in the latter, although, when an obstruction of the bile-duct has lasted long, the jaundice often becomes paler, not from any diminution of the obstruction, but from the secreting tissue of the liver becoming destroyed, and comparatively little bile being secreted; while in cases where there is no obstruction of the bile-duct, the intensity of the jaundice will vary according to the amount of bile which is absorbed, and the degree of derangement of the blood-metamorphosis.

With these preliminary remarks on the pathology of jaundice, we may now proceed to enumerate its different causes, which may be classified according to the following tabular form:—

A. **Jaundice from Mechanical Obstruction of the Bile-duct.**

I. *Obstruction by foreign bodies within the duct.*

1. Gall-stones and inspissated bile.
2. Hydatids and distomata.
3. Foreign bodies from the intestines.

II. *Obstruction by inflammatory tumefaction of the duodenum, or of the lining membrane of the duct, with exudation into its interior.*

III. *Obstruction by stricture or obliteration of the duct.*

1. Congenital deficiency of the duct.
2. Stricture from perihepatitis.
3. Closure of orifice of duct in consequence of an ulcer in the duodenum.
4. Stricture from cicatrization of ulcers in the bile-ducts.
5. Spasmodic stricture.

IV. *Obstruction by tumours closing the orifice of the duct, or growing in its interior.*

V. *Obstruction by pressure on the duct from without, by:—*

1. Tumours projecting from the liver itself.
2. Enlarged glands in the fissure of the liver.
3. Tumour of the stomach.
4. Tumour of duodenum or pancreas.
5. Tumour of the kidney.
6. Post-peritoneal, or omental tumour.
7. An abdominal aneurism.
8. Accumulation of fæces in the bowels.
9. A pregnant uterus.
10. Ovarian and uterine tumours.

B. **Jaundice independent of Mechanical Obstruction of the Bile-duct.**

I. *Poisons in the blood interfering with the normal metamorphosis of bile.*

1. The poisons of the various specific fevers. *a.* Yellow fever. *b.* Remittent and intermittent fevers. *c.* Relapsing fever. *d.* Typhus. *e.* Enteric fever. *f.* Scarlatina. *g.* Epidemic Jaundice.
2. Animal poisons. *a.* Pyæmia. *b.* Snake-poison.
3. Mineral poisons. *a.* Phosphorus. *b.* Mercury. *c.* Copper. *d.* Antimony.
4. Chloroform and ether.
5. Acute atrophy of the liver?

II. *Impaired or deranged innervation interfering with the normal metamorphosis of bile.*

1. Severe mental emotions, fright, anxiety, &c.
2. Concussion of the brain.

III. *Deficient oxygenation of the blood, interfering with the normal metamorphosis of bile.*

IV. *Excessive secretion of bile, more of which is absorbed than can undergo the normal metamorphosis.*

1. Congestion of the liver. *a.* Mechanical. *b.* Active. *c.* Passive.

V. *Undue absorption of bile into the blood, from habitual or protracted constipation.*

Symptoms.—From what has been stated in the preceding section, it is obvious that jaundice is not a disease, but is a symptom of many different diseases. This view of the matter cannot be too strongly impressed upon the student and practitioner, whose efforts must in every case be directed to discover the fundamental malady. There are, however, certain phenomena connected with jaundice, independent of its cause, which deserve to be mentioned.

1. *Intensity of the jaundice.* Next to the liver itself, the skin is the tissue of the body which becomes most deeply jaundiced; but before it becomes affected a yellow tint is usually observed in the conjunctivæ. There must be a certain concentration of bile-pigment to produce a yellow colour of the skin; in the slighter and more temporary cases, the conjunctivæ only may be affected. Although after ligature of the common bile-duct in the lower animals it has been sometimes found that even the conjunctivæ do not become jaundiced for two or three days; in the human subject jaundice of both skin and conjunctivæ is usually observed within twenty-four hours of closure of the duct.

The colour of the skin varies from a pale sulphur or lemon-yellow, through a citron yellow, to a deep olive or bronzed hue. The tint varies according to the cause and its duration. When the cause is obstruction of the bile-duct, it is light at first, and increases in depth the longer the disease lasts; although in advanced cases, as already stated, the colour sometimes becomes paler, not from the obstruction yielding, but from the tissue of the liver becoming destroyed, and very little bile being secreted. In jaundice from obstruction also, the depth of tint often varies from day to day, not from any variation in the degree of obstruction, but according to the amount of bile secreted by the liver, and the eliminative activity of the kidneys. It is well to remember that what is called 'black jaundice' may result from any cause of obstruction—from gall-stone as well as from cancer. In these cases the greenish or almost black hue is due to the absorbed bile-pigment being vitiated and dark, or to the visage being also darkened from imperfect arterialization of the blood, the dark colour resulting from a mingling of the lividity with the colour of bile. When the jaundice is independent of obstruction to the flow of bile, the colour is rarely very deep, and yet these are often the most serious cases. The colour also varies with the age, the natural complexion, and the amount of fat in the individual. It is deeper in the old, the wrinkled, and the dark-complexioned than in young persons of fair complexion, and with plenty of fat. Lastly, it is important to remember that the colour often remains in the skin for some time after the cause of the jaundice has been removed, and that then its departure may be expedited by diaphoretics and warm baths.

2. The *secretions* are tinged with bile-pigment, but some much more so than others. This is notably the case with the urine, by which the greater part of the bile-pigment is eliminated from the body, and which acquires a saffron-yellow, greenish-brown, or brownish-black hue, according to the amount of pigment which it contains. The urine usually becomes yellow before the skin, or even the conjunctivæ; and when the cause of the jaundice is transient, it may happen that the whole of the pigment is eliminated by the urine, without any jaundice appearing in the skin. On the other hand, when once the skin has become yellow, it may remain so for some time after bile-pigment has quite or nearly disappeared from the urine.

Other secretions may contain bile-pigment as well as the urine. The cutaneous glands some-

times eliminate it in such quantity as to stain the linen yellow, but the amount discharged in this way is never great. Instances have been recorded where the secretion of the mammary glands has been tinged with bile-pigment, but they are not very common. Still rarer instances have been noticed where the saliva or the tears have been tinged. It is not a little remarkable that bile-pigment is not eliminated in cases of jaundice by the mucous membrane of the respiratory passages, or of the digestive tube. This is a matter of some practical importance, for, were it otherwise, the stools might contain bile-pigment even when there was complete obstruction of the gall-duct. Still, when either of these mucous membranes is inflamed, and throws off an albuminous or fibrinous exudation, the altered secretions may contain bile-pigment. Thus, when pneumonia coexists with jaundice, there is often bile-pigment in the sputa, which may be distinguished by the nitric-acid test from the greenish or yellow colour often presented by pneumonic sputa, owing to changes in the blood-pigment independent of bile. Indeed, in cases of jaundice bile-pigment may be detected in inflammatory exudations, as in the serum of a blister, before it appears in either the skin or even in the urine. It is probable that those rare cases where the saliva has been noticed to be yellow admit of a similar explanation; in many of them there has been mercurial salivation, a condition in which the saliva is not normal, but contains much albumen.

3. A *bitter taste* is not unfrequently complained of by persons who are the subjects of jaundice. It may denote the presence in the blood of the biliary acids, for taurocholic acid is intensely bitter. It is at all events not due to bile-pigments, which are tasteless. Moreover it is a common symptom in biliary derangements where there is no jaundice.

4. *Derangements of digestion*, such as flatulence, constipation, and an altered character of the motions, may be due to the absence of bile from the motions. Bile is an antiseptic, and when it is absent the intestinal contents undergo fermentation, gases accumulate in the bowels, the motions become putrid, and from the absence of bile they present a pale-drab or clay colour. Bile is also the natural stimulant of the peristaltic action of the gut, and consequently when the supply is cut off, the bowels are usually constipated; but in some cases the putrid fæces act as an irritant and excite diarrhœa. In those cases of jaundice where there is no obstruction of the common bile-duct, the motions may be but little altered.

When bile does not enter the bowel, the digestion of fat is interfered with. Jaundiced patients dislike fat, and do not assimilate it, and the fatty matter in the ingesta may sometimes be detected in the stools. Hence, whatever be the cause of obstruction of the bile-duct, the nutrition of the body suffers: the emaciation may be slow, but it is progressive, until all the fat disappears, and then the weight of the body may remain stationary for many months. With the emaciation there is always more or less muscular debility.

5. *Pruritus*, without any eruption, is a very obstinate and distressing symptom in many cases of jaundice. It is usually worse at night, and by preventing sleep, may wear out the patient. It is chiefly observed in cases of jaundice due to obstruction of the bile-duct. It is not due to the presence of bile-pigment in the blood, for in some cases it precedes the jaundice, and in others it comes and goes during the persistence of the jaundice. Moreover, in many cases of jaundice it is absent throughout, while it is not uncommon in biliary derangements where there is no jaundice.

6. *Cutaneous eruptions.* Urticaria, lichen, boils, or carbuncles are occasionally observed in connection with jaundice; and likewise that remarkable affection of the skin known as *Xanthelasma* or *Vitiligoidea*, the more severe forms of which are in fact almost invariably associated with persistent jaundice.

7. The *temperature* is not altered in jaundice, except when this occurs as a complication of some acute febrile disease, or when there is inflammatory action in the liver itself.

8. *Slowness of pulse.* A common result of non-febrile jaundice is retardation of the heart's action, and diminution of arterial tension. The pulse may fall to 50, 40, or even 20, and sometimes it is also irregular. This slowness of pulse is particularly noticeable when the patient is recumbent. When there has been antecedent pyrexia, the pulse usually falls on the supervention of jaundice. Slowness and irregularity of the pulse are chiefly observed in jaundice from obstruction of the bile-duct, and particularly in those common cases known as catarrhal jaundice; and accordingly they are not unfavourable symptoms, as might have been supposed. So far as the writer's experience goes, patients with this symptom invariably recover. It has not yet been explained why this condition of circulation should be present in some cases of jaundice, and absent in others. The natural explanation would be that it is due to some ingredient of the bile, which does not exist in the blood in all cases of jaundice. Some experiments of Röhrig have shown that the biliary acid salts paralyse the heart, and retard its action, while bile-pigment has no such effect. Slowness of the pulse, therefore, in jaundice may indicate the presence in the blood of unchanged biliary acids; but so far there are no observations to show that bile-acids are present in the urine in these more than in other cases of jaundice.

9. *Hæmorrhages.*—In many cases of jaundice the blood seems to become impoverished, by a diminution in the proportion of red corpuscles and fibrine; and hæmorrhages take place from the various mucous membranes, and into the substance of the skin. This hæmorrhagic tendency is particularly observed in conjunction with cerebral symptoms in cases of jaundice, where there is no obstruction of the bile-duct, but it also occurs in cases of mechanical jaundice of long standing, from any cause, when the secreting tissue of the liver has in a great measure disappeared.

10. *Xanthopsy* or *Yellow Vision.*—In rare cases of jaundice, all white objects appear to the patient yellow. The administration of santonin internally has also sometimes been followed by yellow vision, which has ceased as soon as the

colouring matter has been eliminated by the kidneys. This fact, as well as the observation that in several cases of jaundice, with xanthopsy, the conjunctival vessels have been preternaturally distended with blood, has led to the belief that the symptom is due to a tinging with bile-pigment of the humours of the eye. On the other hand, the circumstances that the xanthopsy may intermit, without any change in the jaundice; that it is usually absent when there is intense jaundice of the cornea and other tissues of the eye; and the statement that it may occur in typhus fever and in certain derangements of vision, such as night-blindness, when there is no jaundice, have led some authorities to regard it as a purely nervous symptom.

11. *Cerebral symptoms, and the Typhoid state.* Patients with jaundice are often irritable in their temper and hypochondriacal; and occasionally they are attacked with acute delirium, stupor, coma, convulsions, muscular tremors, subsultus, carphology, paralysis of the sphincters, a dry and brown tongue, and other indications of the typhoid state. These symptoms are most common in cases where there is no obstruction of the ducts, but they also occur in cases of obstruction, usually of long standing, where all or the greater part of the secreting tissue of the liver has been destroyed. Different opinions are held as to their cause. After death no lesion is found of the brain or its membranes, and they are, therefore, most probably due to some alteration of the blood. They are commonly attributed to poisoning of the blood with bile, either from suppression or re-absorption of the secretion. But the assumption that the elements of the bile are preformed in the blood has been already shown to be probably erroneous; and there is equally little evidence that bile is possessed of poisonous qualities, or that its presence in the blood, even to saturation, will give rise to cerebral symptoms. Many experiments have been performed on animals to show that bile is a deadly poison; but there is reason for believing that the bad results observed have been due to the injection into the areolar tissue of decomposing mucus contained in the bile. Bile, from which the mucus has been removed, has been repeatedly injected by Frerichs and other observers into the large veins of dogs, without cerebral symptoms or any bad results ensuing, except that death has in some instances been caused by the entrance of air into the veins. But it is scarcely necessary to turn to experimental enquiries on the lower animals for evidence on the matter, and in all these experiments there are sources of fallacy. There is ample proof that the blood of the human subject may be saturated with bile for months, or even years, without any cerebral symptoms resulting. Dr. Austin Flint, jun., is of opinion that the cerebral symptoms of jaundice are due to the retention of cholesterine in the blood, or to what he has designated *Cholesteræmia*. Cholesterine is one of the constituents of bile, and Dr. Flint regards it as an excrementitious product of nervous tissue, the elimination of which from the body is one of the functions of the liver, and the retention of which in the blood he believes to act as a poison like urea. But if the non-excretion of all the elements of bile does not give rise to cerebral symptoms, it is difficult to understand how they can result from the retention of cholesterine alone. In cases, for instance, of permanent closure of the bile-duct, cholesterine is not discharged from the liver into the bowel, nor does it accumulate in the biliary passages, and yet, if it be retained in the blood, cerebral symptoms rarely occur.

The cerebral symptoms in jaundice are often most severe when the jaundice is slight, and they may occur in diseases of the liver when there is no jaundice. They are best explained by the knowledge which we now possess of the function performed by the liver in disintegrating albuminous matter into less complex substances, such as urea and uric acid, which are eliminated by the kidneys. When this function of the liver is arrested or seriously impaired, urea is no longer eliminated in sufficient quantity by the kidneys; lithic acid and deleterious products of disintegrating albumen even less oxydised, such as leucin and tyrosin, and perhaps others with which we are as yet imperfectly acquainted, accumulate in the blood and tissues; the result is the development of symptoms of blood-poisoning similar to those which arise when the kidneys are unable to eliminate the products of albumen-disintegration, owing to disease of their own structure, or to an excessive formation of urea and other products, as happens in many febrile diseases. In acute atrophy, for example, the structure of the liver is destroyed, and its functions are arrested; leucin and tyrosin take the place of urea in the urine, and are also found in large quantity in the liver, spleen, and kidneys; while cerebral symptoms and the typhoid state are prominent features of the disease.

Diagnosis.—There is rarely much difficulty in the diagnosis of jaundice, but it is well to remember that certain conditions are sometimes mistaken for it, such as chlorosis; the anæmic aspect resulting from organic visceral disease (and particularly from contracted kidneys), from cancer, from exposure to malaria, from Addison's disease, or from lead-poisoning; an undue amount of sub-conjunctival fat; or an unusually dark colour of the ordinary urinary pigment, or the presence in the urine of abnormal pigments, such as those of santonin, turmeric, rhubarb, &c. In every case where there is the slightest doubt, it will be removed by resorting to the nitric acid test for bile-pigment in the urine. If this gives no result, the case is not one of jaundice.

But it is a more difficult matter to determine the cause of the jaundice, and yet this should invariably be the aim of the medical attendant, before forming a prognosis or proceeding to treatment. The scope of this article does not permit a lengthened analysis of the characters distinguishing the different forms of jaundice according to its cause, but the following remarks may be of some service.

1. In the first place it is always well to determine whether or not the jaundice be due to obstruction of the bile-duct. According to Dr. G. Harley this can be done by determining the presence or absence of bile-acids in the urine. Adopting the view that bile-acids are formed by the liver, while bile-pigment is preformed in the blood,

he contends that in jaundice from 'suppression' (or independent of obstruction) the liver does not secrete bile, and consequently no bile-acids being formed, none can enter the circulation or be detected in the urine; whereas in jaundice from obstruction, bile is secreted and absorbed into the blood, and a portion of the bile-acids not transformed in the circulation appears in the urine. But in addition to the strong improbability already urged that any form of jaundice is due to a *suppressed secretion* of bile, clinical experience is entirely opposed to the practical value of the test in question for throwing light on the cause of jaundice. Bile-acids have been found in the urine in cases of acute atrophy of the liver, where there is no obstruction of the bile-duct, and in very many cases of mechanical jaundice they are certainly absent. A more reliable indication of obstruction of the common bile-duct is furnished by the stools. When there is no obstruction, the stools almost invariably contain bile; but when the duct is obstructed, they are clay-coloured. The rule is not without exceptions, and there are several sources of fallacy. The jaundice usually persists for some time after the duct has become pervious, and thus bilious motions may co-exist with jaundice which has resulted from obstruction; or, if the motions be thin and watery, they may appear to contain bile from the admixture of jaundiced urine; or, not unfrequently, when the bile-duct is quite impervious, the motions are of a brownish tinge, owing to the presence of altered blood, which may closely resemble dark bile. A tumour corresponding to the region of the gall-bladder will favour the view that jaundice is due to obstruction of the bile-duct. Lastly, jaundice which persists and is yet slight, is most probably independent of obstruction, for jaundice from persistent obstruction speedily becomes intense.

2. It is always important to note the mode of commencement of jaundice. That which appears suddenly in a person whose previous health has been good, is most probably the result of obstruction of the duct by a foreign body, or it has a nervous origin. The former cause will be distinguished by biliary colic, vomiting, and clay-coloured stools. On the other hand jaundice coming on slowly, but ultimately becoming intense, with clay-coloured stools, points to pressure on the duct from without, or to a growth in its interior.

3. A history of previous attacks of jaundice of a similar nature is in favour of a catarrhal origin or of gall-stones.

4. Pain in severe paroxysms concurring with jaundice points generally to gall-stones or cancer; more rarely to hydatids, or to an aneurism of the hepatic artery. Cancer is distinguished from gall-stones by there being usually a history of failing health and emaciation before either the pain or the jaundice.

5. Jaundice concurring with enlargement of the liver is most probably due to cancer or cirrhosis; more rarely to pyæmic abscesses, or to waxy liver, with large glands in the portal fissure.

6. Jaundice concurring with ascites points to cancer or cirrhosis. The diagnosis of the latter will usually be assisted by the physiognomy, the slightness of the jaundice, the previous habits, and a history of alcoholic dyspepsia; while in cancer there are often darting pains, and the jaundice is usually intense.

7. Jaundice concurring with pyrexia is either secondary to some acute febrile disease; or is due to suppurative pylephlebitis, a suppurating hydatid tumour opening into a bile-duct, or inflammation of the bile-ducts. Temporary pyrexia may also occur during the passage of a gall-stone.

8. Cerebral symptoms associated with jaundice suggest acute atrophy of the liver, poisoning by phosphorus, some specific fever, pneumonia, or nervous shock.

9. Jaundice in a young person, preceded by symptoms of gastric catarrh, is most probably catarrhal.

Treatment.—There is no special treatment for jaundice; in all cases the treatment must have reference to what is believed to be its cause. The appropriate treatment will therefore be discussed under the head of the several diseases which give rise to it. Here it is only necessary to observe, that in all cases of jaundice from obstruction it is important to maintain the action of the kidneys, which are the main channel for the elimination of the bile; while portal congestion is obviated by appropriate purgatives. The part which the bile plays in assisting assimilation of nutriment may to some extent be supplied by ox-gall; and creasote will often check the diarrhœa excited by the putrefying fæces. Patients suffering from jaundice ought also to partake sparingly of fatty or saccharine food, or of alcoholic drinks.

Charles Murchison.

JEJUNUM, Diseases of. *See* Intestines, Diseases of.

JIGGER.—A popular term employed to designate the sand-worm or sand-flea. *See* Chigoe.

JOINTS, Diseases of.—Diseases of the joints are classified according to the structure primarily or chiefly involved. They may commence in the synovial membrane, in the bone, or in the cartilage. Primary disease of the ligaments is rare, and is not clinically demonstrable. No form of joint-disease remains long confined to one tissue, so that when the disease is of some duration it will be found to implicate, more or less, every element of the joint-apparatus. In this article the diseases of joints will first be generally discussed; and the individual diseases will then be considered separately.

Ætiology and Pathology.—The larger articulations, those in constant use, and more especially the joints of the lower extremity, are the most frequently diseased. Thus the knee is more often the seat of disease than any other joint; the hip-joint comes next in order; and then the ankle and elbow. All kinds of joint-diseases are frequent in children and young persons. The first year of life appears, however, to be nearly exempt from these affections, and during the second year they are comparatively rare, perhaps because movement and risk of injury are at that period at a minimum.

Acute arthritis, however, is occasionally witnessed during the first year of life—during even the first six months. It is unconnected with syphilis or injury; very sudden in its appearance, and rapid in course; dangerous to life; and destructive to the articular ends of the bones by suppurative disorganisation. The causes of joint-disease in general are connected either with disordered nutrition, in which case it usually assumes an inflammatory type; or with disordered function. The latter may depend on the former, or be unconnected with it. Again, the cause may be local in its origin, or arise from some constitutional defect. Amongst the *exciting* causes, injury is by far the most frequent. This being often slight, and not followed by any immediate consequences, the connection is frequently overlooked. A blow, or a fall against the edge of a table or down stairs, may readily bruise the synovial membrane, in such exposed joints as the knee or elbow, without causing any external sign. A slight hæmorrhage takes place into the synovial cavity or the subsynovial areolar tissue, and serous effusion may speedily supervene; in this manner a common variety of acute or traumatic serous synovitis is produced. But although injury is the most fertile cause of joint-disease, the articulations may sustain most severe injury without becoming inflamed. It is rare to find any serious consequences result from dislocation; the joint usually perfectly recovering itself. Penetrating wounds of the joints are always serious injuries; they often occasion acute synovitis, and if septic changes occur, are followed inevitably by suppuration in the articulation, and danger both to the limb and life of the individual. Fractures often implicate the joint-surfaces, and prove a frequent source of stiff-joint. Plastic synovitis may be thus set up, causing adhesions; or suppuration takes place; or the callus formed for the repair of the fracture may interfere with the joint motion. Gunshot wounds often produce the severest form of inflammation of joints, suppuration being the usual result. When joint-disease follows an injury it is usually confined to one joint; but when joint disease originates from constitutional causes, more than one joint is often affected; or when only one, the constitutional nature of the cause is manifested in diseased conditions present elsewhere, or by traces of inflammation in other joints, due to the same cause. The deposit of tubercle in the synovial membrane and bone is a frequent cause of chronic joint-disease.

Joint-inflammations are of common occurrence in all kinds of fever; and also as sequelæ of the exanthemata. The great frequency of polyarticular serous synovitis in acute rheumatism is well known, as also in purpura and hæmophilia, where it is complicated with blood-extravasations. In pyæmia the joints are frequently the seat of sero-purulent and purulent effusions; as they also occasionally are in scarlatina. Puerperal synovitis is a variety of the pyæmic. In typhus monarticular arthritis is frequently met with, and the hip is the joint oftenest affected. Endocarditis and polyarthritis are very often associated together, and the endocarditis may precede and give rise to the joint-disorder by embolism. The fact that multiple joint-affections are met with both in pyæmia and in rheumatism suggests a connection, but what its nature may be is not clear. Although in articular rheumatism pus-formation is rare, we sometimes witness joint-suppuration in such cases; whilst pyæmia and metastatic abscess may originate from ulcerative endocarditis. In chronic synovitis, affecting two or more joints, the heart should always be examined, for traces of endocarditis will sometimes be found. In the exanthemata, typhus, and diphtheria, metastases in the shape of joint-inflammations more or less frequently take place. Joint-inflammation is of frequent occurrence in dysentery. With gonorrhœa a form of arthritis is associated which is called 'gonorrhœal.' Syphilis in the later stages frequently attacks a joint, the knee by preference, syphilitic deposits taking place in the bone or the subsynovial connective tissue, but synovial effusion is not common. A suppurative inflammation of the ends of the bone is not rare in children the subjects of inherited syphilis. In gout the joint-structures are affected; as a rule the perisynovial tissue becomes inflamed owing to deposits of urates. Similar deposits even occur in cartilages of encrustation. The great toe is most often affected, but the other tarsal, digital, and larger joints are frequently diseased.

Some ill-understood form of vaso-motor or trophic irritation appears to occasion arthritis, in locomotor ataxy. Effusion into the joint is preceded by pain, and the knee and shoulder joints are those generally affected. In some cases of the disease changes similar to those in rheumatoid arthritis have been observed, generally in the knee, shoulder, elbow, or hip. They occur early in the disease; arise suddenly; are often monarticular; and not rarely give rise to dislocation, especially in the shoulder. These characters distinguish the disease from ordinary rheumatoid arthritis. Severe inflammation of the joints of the paralysed limbs has been observed in cases of hemiplegia. The occurrence of joint-disorder, usually synovial inflammation, is frequent in chronic disease of the spine; and it also occasionally happens in acute myelitis, in the form of suppurative arthritis. In both cases the knee is most frequently affected.

Anatomical Characters.—Joint-disease may begin as an inflammation of the synovial membrane, of the bone, or of the cartilage. Fibrous tissue having but slight tendency to inflame, it is improbable that primary disease affecting the ligaments can be otherwise than most exceptional; but these textures very soon become secondarily affected, from their intimate connection with the synovial membrane. The synovial membrane is perhaps more ready to inflame than any other tissue in the body, and in many joints it is much exposed to injury from without, while excessive joint-movement alone is sometimes sufficient to excite synovitis. Primary disease of the bone comes next in order of frequency Cartilage is least likely to take on primary disease. Each of these tissues, however, becomes speedily affected by disease which has invaded or commenced in the other.

Symptoms and Diagnosis.—The local symp-

toms of joint-disease have reference to *impairment of function*, and *change in form*; together with *pain*, both local and sympathetic; and certain *physical signs*.

Impaired function.—Usually this is great in proportion to the natural mobility and importance of the joint, and most evident in the extremities. The earliest symptom in hip-joint-disease is a slight limp or halt, whilst in other joints mere stiffness occurs; the full range of movement is simply curtailed, before actual pain or swelling takes place. The position of maximum relaxation, namely, that intermediate between flexion and extension, is commonly assumed by diseased joints. Even in the earliest stages of disease, the interference with movement is often very great, amounting to a sort of vital anchylosis, produced by the action of the muscles, whose tension prevents the joint-surfaces moving upon each other—an effort to avert pain. This form of anchylosis disappears during narcosis. Muscular or vital anchylosis must be distinguished from the rigidity produced by structural changes. Both synovial effusion and peri-synovial infiltration mechanically hinder free joint-movement.

Changes in form.—Changes in form are due to the alterations in shape and texture of the joint-structures, and to effusions within its cavity. These changes may be best appreciated by careful measurements, and a comparison with the opposite joint. No true estimate of the amount of departure from the normal is otherwise possible. The practitioner is thus better able to diagnose the special character of the swelling, whether it be due to synovial effusion, and confined to the limits of the capsule, causing it to bulge at the least protected parts; or to chronic thickening of the synovial membrane, recognised on palpation by its elasticity and general diffusion; or to disease of the bone and periosteum, when the swelling is deep-seated and hard. By accurate comparison a fluid collection outside the joint, either an abscess or a bursal tumour, may be distinguished from intra-articular swelling.

Pain.—The character of the pain is an important symptom in diseases of the joints. In acute synovitis it is severe and lancinating. In bone-inflammation it is a dull aching pain, with marked local tenderness, liable to periodic exacerbations of an intense kind. Often the pain is of a shooting, starting character, wakening the sufferer from sleep. The pain is of this character and most severe in subarticular ostitis. Pyæmic suppuration and chronic synovitis are generally painless.

Physical signs.—When one hand is laid flat upon a diseased joint while the other moves it, certain sensations or sounds are often distinguishable. A peculiar soft crepitation due to the presence of blood-clot, must not be mistaken for the rougher sensations which adhesions afford, the friction-sounds of movable joint-bodies, or the grating of exposed bone. The rubbing of one granulation-surface upon another may be likened to that of two pieces of velvet. Abnormal movements, such as lateral motion in a ginglymoid joint, usually imply extensive joint-disorder. Displacement or partial dislocation, and alteration in form of the joint-surfaces occur as the disease progresses. A notable increase of local heat may be felt in all inflamed joints. When fistulous tracks exist around a diseased joint, they do not often afford direct evidence on being probed of the condition of the joint, but they generally prove the existence of articular suppuration, and disease of the bone.

With respect to the general symptoms of diseases of the joints, it need only be said here that the amount of pain or constitutional disturbance in acute cases varies according to the extent and acuteness of the disease, and the presence and amount of suppuration. In chronic disorders the associated constitutional condition should be investigated.

Complications and Sequelæ.—The complications which occur in joint-disease are generally connected with long-continued suppuration. Amyloid degeneration of the viscera is pretty certain to be present when suppuration has existed for a year or more in young people; less certainly in adults. Hectic fever, tuberculosis, or pyæmia may occur at any period. In the absence or failure of treatment, the patient, should he survive, will suffer from contraction, deformity, and imperfect growth of the limb, together with more or less complete loss of function.

Prognosis.—The prognosis in diseases of the joints will depend on many circumstances, and must be considered both as regards life and as regards function. First, with respect to *life*, the gravity of joint-diseases increases with the size of the joint affected. They are more serious in the lower than in the upper limb. Pyæmia is comparatively rare in acute joint-suppurations—why, it is impossible to say. When pus escapes from the interior of a joint into the surrounding tissues, pyæmia may occur. A continuous high temperature, or a large evening increase associated with hectic, are bad signs; the exhaustion, which depends on profuse suppuration with its attendant hectic fever, amyloid degeneration, and tuberculosis, being the most frequent causes of death in joint-disease. The prognosis as regards *function* is often difficult to determine. After an attack of simple acute or subacute serous synovitis, recovery is generally complete. Joint-function is usually completely lost after suppuration of traumatic origin, recovery being quite exceptional. When the suppuration is of a pyæmic nature, and the patient survives, the effusion may become absorbed, and the joint-motion be preserved. Chronic synovitis with thickening of the subsynovial tissue, due to infiltration with granulation-material, can seldom be cured except by operation, especially after suppuration has taken place. If recovery should ensue, the joint-function is lost, and deformity is always present. Increased mobility—'flail joint'—is a very rare sequence of joint-disease. It is occasionally seen in the shoulder, and also in the knee.

Treatment.—The treatment of diseases of the joints must be directed to preserve the life of the individual; and, as far as possible, the functions of the limb. Of the first and greatest importance among remedial measures is *rest*, which is best secured by fixation of the joint and limb in an appropriate apparatus. This is of cardinal importance to a diseased articulation, just as

motion is a necessity for a healthy one. Immobilisation should not be continued longer than necessary; it will sometimes seriously damage even a previously healthy joint, immobilised on account of fracture of the limb; and a continuance of rest after all diseased action has subsided often exerts a very prejudicial influence. Rest, however, should be continued so long as pain and increased temperature persist.

Position.—The same means adopted to secure immobility must be utilised to obtain the best available position for the future function of the part, should anchylosis become inevitable. In the ankle the foot should be maintained at a right angle; the hip and knee must be extended in the axis of the body; the elbow is generally flexed to a right angle, the position in which the limb is most useful. Splints of various forms are used, and we possess in plaster-of-Paris and starch ready and invaluable means of producing an apparatus, which gives uniform and equable support of a simple and very perfect kind.

Extension exerts a beneficial influence, as well by immobilising the joint, as by its power to remove contraction and deformity. It relieves pain and abates the symptoms rather by keeping the joint at rest, and changing the surfaces of contact, than by any actual distraction of the joint-surfaces. A much greater weight than a patient could tolerate must be used before any such separation could occur. Extension often even increases the intra-articular pressure. By straightening the limb it removes the joint from its position of maximum relaxation, and puts the skin and tendons on the flexor aspect on the stretch, and alters the mutual accommodation of the joint-surfaces.

As there is almost invariably an increase of temperature in the affected joint, the application of *cold*, by means of ice-bags or coils of cold water tubing, is indicated. Cold acts most beneficially in all acute, and many subacute inflammations. Even in deep-seated joints like the hip, it will often soothe the pain and abate the symptoms, but it is more applicable to the superficial joints. Cold is both anæsthetic and prophylactic in its action. The sensations of the patient in respect of the continuance of cold applications must be consulted. In most cases they are grateful. In chronic joint-affections when an acute attack supervenes, threatening suppuration, cold should also be applied. Cold applications may in some cases be continued for weeks or months with advantage. When the acute symptoms have passed off, and it is desirable to encourage lymphatic activity and absorption, the cold must be discontinued, and compression, together with friction and warmth, substituted. Cold is not applicable to purely chronic cases without much pain or tenderness.

In some instances of acute and subacute arthritis *local depletion* by means of leeches or scarification is very useful, and this may be combined with hot *fomentations* in cases where cold is not well borne. In chronic inflammation of the bone the *actual cautery* sometimes procures immediate abatement of the pain, and, after a time, the subsidence of the inflammation. The button cautery may be used, or, still better, linear cauterisation, over the most sensitive points. Or an *issue* may be employed instead.

Compression by strapping, or with a thick layer of cotton-wool and a tightly applied bandage over it, is applicable to the chronic stages of joint-disease. It must be discontinued if it occasion pain. It is better calculated to remove fluid effusions than the plastic material poured out into the perisynovial tissue. For these cases the more continuous compression of a properly applied elastic bandage will prove more efficient; or the strapping known as 'Scott's dressing.'

Massage is a most valuable local means for the dispersion of chronic swellings of joints. It both removes the results of diseased action in the joint, and helps to restore its function. It is well suited to disperse serous effusions when the acute stage is over; for cases of plastic synovitis it is also useful, but not for cases of the type known as *tumor albus*. It produces a diminution of the sensibility of the part, and a local increase of temperature, and the lymphatics are stimulated to increased activity. There are several modes of employing massage. The first is centripetal stroking with the palm of the hand from the periphery of the affected part towards the centre of the body, called *effleurage*, one hand following the other in immediate succession. The amount of pressure varies with the circumstances of the case. This will readily disperse fluid effusions both of blood and serum. Friction-massage is another useful method, and is practised by pressing the palm firmly upon the surface, and then rotating it. This plan may be combined alternately with the last method, massage proper—*petrissage*—which is done by raising up the soft parts vertically from the bone with both hands, and compressing them, always in a centripetal direction.

Forcible movements. — Forcible movements, which break-down adhesions, are often most useful in cases of stiff joint arising after protracted immobilisation, after fracture in the vicinity of a joint, or after a severe sprain. Pain will be relieved in this way, and mobility restored in some instances, in a degree quite remarkable.

Constitutional treatment.—Where any general taint exists, this must be treated at the same time. A tendency to tubercle must be met by iron, tonics, good food, and fresh pure air. Gout, syphilis, or rheumatism must, when present as a diathesis, be appropriately treated.

Operative treatment.—Puncture alone, or combined with antiseptic washing-out of the articulation, may often be performed with advantage, to evacuate the fluid in a distended joint, or to diagnose the presence of pus and evacuate it when suppuration has taken place. Sufficiently free incisions, however, and the insertion of drainage tubes are generally to be preferred in cases of joint-suppuration; and with these should be combined the washing-out the joint-cavity with a three- or five-per-cent. solution of carbolic acid, or other adequate antiseptic. It has been proposed to substitute free incisions and drainage for excision of the joint, in certain chronic forms of disease, such as white-swelling, but excision is probably in most respects preferable. Excision is practised for chronic joint-disease not amenable to other means; it is not a substitute

for amputation, but is intended to obviate its necessity. Subperiosteal resection, where practicable, possesses many advantages, especially in cases of traumatic origin. The attachments of the muscles and tendons, and the cellular interspaces between them, are thus left undisturbed. The chances of perisynovial suppuration are diminished, and the bleeding is reduced to a minimum. There is more complete bony reproduction of the joint-surfaces, and in young persons a new joint very similar to the normal is in some instances formed, while in all cases there is a probability of better subsequent function and position. The operation thus performed requires time and skill. It is scarcely applicable to the knee or even the hip, and is unsuited for cases of chronic synovial disease, where it is of the last importance to excise all the diseased granulation-material. The after-treatment of excisions is of great importance. Plaster-of-Paris bandages supply one of the most useful means of immobilisation, especially in those cases where anchylosis is sought for, as in the knee; and the splint should be unchanged, if possible, for four or five weeks. In the elbow, shoulder, and wrist, where mobility is the end aimed at, passive movement should be commenced as soon as the condition of the wound admits of it, namely in about a week or ten days. Galvanism must be used at a later period to restore the wasted muscular apparatus.

Amputation is only performed as a last resort. It is very rarely needed for joint-diseases in the upper limb, except perhaps the wrist, when the hand is permanently crippled. In the lower limb, amputation must be performed in those cases in which the patient has lost all strength and healing power, from the drain of a long-continued discharge. It is advisable where amyloid degeneration or incipient tuberculosis exists, or in any case, in short, in which the power of the patient is inadequate to furnish the amount of repair required in the expectant form of treatment, or in case of excision, always a more serious operation than mere amputation. Amputation should also be adopted in those cases in which the local disease, especially of the bone, is too extensive to admit of a good functional result after excision. In the very young excision is very undesirable, since the epiphysis is almost of necessity sacrificed, and the growth of the limb checked. Resection in some joints is practised to avert anchylosis, or to restore the lost function of the joint, as in the shoulder, elbow, and wrist. Various congenital and other deformities of the joints may be removed by osteotomy of the bones concerned.

The chief diseases of joints will now be separately considered in alphabetical order as follows:—1. Cartilages, Diseases of; 2. Congenital Dislocation; 3. Immobility; 4. Inflammation, Acute, of the Synovial Membrane: 5. Inflammation, Chronic, of the same; 6. Gonorrhœal Inflammation; 7. Gouty Inflammation; 8. Strumous Inflammation; 9. Loose Cartilages in Joints; 10. Nervous Affections; 11. Rheumatic Arthritis, Chronic; 12. Serous Effusions; and 13. Syphilitic Disease. Rheumatism in its several forms will be considered separately.

1. Joints, Cartilages of, Diseases of.—Primary chondritis as a form of joint-disease is neither clinically nor pathologically established. The cartilage has little tendency to active inflammation; it is not sensitive to pain; chronic changes take place in it as the result of impaired nutrition, rather than inflammation. The cartilages of encrustation are the residue, which does not ossify, of the mass of fœtal cartilage forming the bone-ends. We meet in the joints of the aged with depressions and fibrous scars, caused by partial atrophy of the cartilage; these changes do not occasion symptoms during life, beyond sensations of creaking and roughness in the joint when moved.

Almost all the changes which occur in the articular cartilages are secondary to synovitis and ostitis, and more or less passive. In serous synovitis the cartilage is softened and swollen, and becomes to a certain extent œdematous. In suppurative synovitis it becomes rough, sodden, and yellow; its cells burst; the intercellular substance fibrillates; and portions may necrose. The cartilage-changes in chronic synovitis have been already discussed, and others will be referred to later.

Young growing bones, like the periosteum covering them, readily inflame; and as soon as the inflammation invades the articular surface of the bone, the cartilage becomes loosened and necrosed, or invaded by the granulation-tissue springing from the bone. The cartilage is softened; its capsules burst; fibrillation occurs; and at different places it becomes thinned. Perforations occur in it, leading to the bone, giving it a sieve-like appearance. Where the inflammatory process is more acute, the whole of the encrusting cartilage may become at once detached from the bone beneath.

In these cases the pain, especially at night, is very severe. Involuntary starting of the limb causes intense suffering, wakening the patient from sleep with a scream. This symptom was formerly considered distinctive of ulceration of cartilage, a process which is wholly painless when it occurs without other disease in the joint, but it is probable the pain is due to pressure upon the inflamed bone, and it will sometimes greatly abate when the cartilage wholly disappears. Disease commencing near the epiphyseal cartilage often extends to the adjacent joint. Those joints in which the epiphyseal junction is within the capsule, as, for instance, the hip, run a double risk from bone-inflammation.

2. Joints, Congenital Dislocation of.—DESCRIPTION.—This is a curious and ill-understood affection of the joints. It is almost exclusively confined to the female sex. The hip-joint is nearly always the one affected, and the displacement is generally double. It has often been erroneously mistaken for morbus coxæ, and treated accordingly.

It probably occurs in early fœtal life from defective formation of the joint-surfaces. It is not discovered until the child begins to walk, which it generally only commences to do at a late period. When the hips are affected, the gait is accompanied by a most ungainly swaying of

the body from side to side like the waddling of a duck. All that can be done is to supply a well-contrived artificial support to the pelvis and limbs.

Genu valgum and *genu varum* (knock-knee and bow-knee) are two forms of disabling and unsightly deformity of the lower limbs. They are often due to an abnormal development of the condyles or shaft of the femur, or the tuberosities of the tibia, and to changes of a rickety character at the epiphyseal junction. In extreme cases progression is greatly interfered with. The symptoms are painfully obvious.

Treatment. — Treatment of the limb by splints and apparatus and forcible straightening in plaster-of-Paris bandages succeeds in the milder cases, but in those of a severe type, or in persons of ten years or upwards, this plan is most tedious, and is usually attended by complete failure. The subcutaneous division of the internal or external condyle, according to the nature of the deformity, restores the joint-surfaces of the femur to their normal level, and is attended by the happiest results both to the form and function of the limb and joint. It is an easier and in many ways a more successful operation to divide the shaft of the bone with a chisel near its articular extremity, and thus procure the rectification of the limb.

3. **Joints, Immobility of.**—Synon.: Anchylosis; Fr. *Ankylose*; Ger. *Gelenkverwachsung.*

Ætiology.—This condition may be due to changes in the structures of the articulation—*true anchylosis*; or in those surrounding the joint—*false anchylosis.* It may be fibrous and incomplete, or bony and complete. False or spurious anchylosis—extra-articular—may depend on muscular spasm or rigidity; on cicatricial contractions; on paralytic or spasmodic affections; or upon prolonged disuse of the joint. It is often difficult, even under chloroform, to distinguish the presence of absolute bony anchylosis, as the fibrous form may be so strong and extensive as almost wholly to prevent movement. The two varieties are but degrees of the same process. Both may result from previous inflammatory changes in the joint, either of the nature of plastic synovitis, or of granulations springing from the bone and other joint-tissues, becoming further organised. Fibro-cartilaginous anchylosis is a common form in young persons. In time it usually becomes converted into true bony anchylosis.

The marked anchylosis which tonic spasm and rigidity of the muscles produce in the early stages of some joint-diseases, as in the hip-joint and knee, may be called *vital* or *physiological.* It is induced by an effort to avert pain; it disappears entirely during narcosis. A joint may become stiff and anchylosed by long fixation on account of some injury or disease elsewhere, especially if it be retained in a flexed position, as the muscles of the flexor side actually shorten when their points of origin and insertion permanently approach one another. The same thing may also happen in the myogenic affections due to paralysis; in which the cartilages and bones atrophy at the same time.

Treatment.—The treatment of diseases of joints should, in all cases where it is possible, be prophylactic against the occurrence of anchylosis. When this has taken place in an incomplete degree, an attempt to restore the function of the limb must be made by breaking down the adhesions by forcible or gradual extension, by passive motion, by massage, and by tenotomy of the tense tendons. Excision is indicated to restore motion in complete anchylosis of such joints as the wrist, the elbow, and the shoulder. In other cases of complete anchylosis, especially in the lower limb, surgical interference should be confined to an attempt to rectify a faulty position either by tenotomy, extension, forcible straightening, excision, or osteotomy. Amputation can only be needed in extreme and otherwise irremediable deformity.

4. **Joints, Inflammation, Acute, of the Synovial Membrane of.**—Synon.: Acute Synovitis; Fr. *Synovite*; Ger. *Synovitis.*

This is one of the most common of all joint-affections. Probably in half the total number of chronic joint-diseases the synovial membrane is first affected. The synovial membrane is very rich in vessels and cells; and much exposed to injury, and to the effects of joint-movement. An inflammation beginning at one point soon spreads over the whole synovial sac.

Description.—Acute synovitis is a very common result of injury; it also occurs in rheumatism, gout, pyæmia, and other diseases. It may be serous, sero-fibrinous, or purulent. Serous synovitis is the simplest and most common variety. Even a slight external injury is often sufficient to produce it; a sprain of the joint, or even excessive movement, may cause it, as well as the constitutional disorders already mentioned. The knee is very often affected, from its exposed position and the large area of the serous membrane lining it. The synovial membrane becomes injected and thickened, with œdema of the subsynovial tissue. The natural secretion is increased in quantity, and many cells are shed into the joint cavity, the capsule becoming swollen, tense, fluctuating, or elastic. The least protected parts bulge, from the pressure of the effused fluid, and the normal contour of the joint is lost. It is usually semi-flexed. A severe burning, cutting pain is experienced in it. It is exceedingly sensitive to pressure, and painful on the slightest movement. There is usually considerable fever. When the inflammation is more intense, the synovitis becomes sero-fibrinous. Flakes of lymph are mingled with the synovia; layers of false membrane cover the synovial membrane, which is considerably thickened and dull red in colour; and the constitutional disturbance is greater. Finally, it is but a short step from this to suppurative synovitis. If the irritant cause continue its action, the leucocytes filling the meshes of the synovial membrane are shed in larger quantity; the fluid becomes turbid and puriform; the fever and local symptoms increase very much in severity; the external parts become implicated in the inflammation within; and joint-suppuration or abscess is the result.

Treatment.—The treatment of the first two stages of synovitis is directed primarily to check

the progress of the inflammation; and then to procure resolution, and absorption of the effused fluid. Fortunately the synovial membrane possesses very active absorbent powers; and early and efficient treatment, conjoined with removal of the source of irritation, will generally ensure a cure, with complete restoration of function. The chief means are cold applications; immobilisation till the acute stage is over; and then compression and friction, or in suitable cases counter-irritation. Gout, rheumatism, or other diathesis, must be appropriately treated at the same time.

In those cases in which the inflammation has persisted for some time, and plastic effusion has taken place on the surface and in the substance of the synovial tissue, the joint will remain for a long time stiff and thickened, and its function impaired, after all acute symptoms have subsided; whilst in those cases where the inflammation has continued long enough to invade the other joint-structures, a perfect cure may not be possible.

When suppuration occurs, the joint must be dealt with as any other abscess-cavity. Free incisions must be made into it, and it should be thoroughly washed out with some antiseptic solution, free subsequent drainage being provided for. In the more favourable cases, anchylosis in a convenient position will be obtained. Recovery of function is very rare. In other cases the suppuration continues; the cartilages of encrustation become necrosed and detached; the bone becomes exposed and carious; and either excision or amputation must be performed to save the patient's life or limb.

5. Joints, Inflammation, Chronic, of the Synovial Membrane of. — Synon.: Chronic Synovitis.

Chronic synovitis may arise as the sequel of the acute disease; or, as is more frequent, it may depend on some constitutional dyscrasia, or at least some continuously acting irritant, although in the first instance it is generally excited by an accidental injury.

Varieties.—There are three chief varieties of this disease which are often co-existent, namely: —*Pannus Synovitis*, *Granulation Synovitis*, and *Papillomatous Synovitis*.

a. Pannus Synovitis.—In this variety a delicate membrane will be found, stretching from the inflamed and thickened synovial margins more or less over the surface of the cartilage, to which it may be in whole or in part adherent.

b. Granulation Synovitis.— The second, or granulation-form, is a more advanced stage of the disease. In it the synovial membrane is often completely replaced by granulation-material, which encroaches on the margins of the cartilages, and, as the disease progresses, invades them, and coalesces after a time with granulations springing from the inflamed bone. These granulations are pink or greyish-red, not so vascular as those in an ordinary wound. They have little tendency to cicatricial change, and are prone to soften down and form abscesses.

The synovial membrane often becomes enormously thickened from the granulation-material accumulated in it, and this form of disease is frequently associated with the tuberculous diathesis. Bodies identical with miliary tubercles are very often found in the semi-gelatinous or pulpy synovial membrane; the whole constituting what is known as *tumor albus*, or 'white-swelling.'

Symptoms. — The more prominent symptom associated with the form of chronic synovitis just described is the presence of a uniform semi-elastic swelling, caused by the sero-fibrinous infiltration of the synovial membrane. The skin is whitish, tense and smooth, whence the name *tumor albus*. The amount of synovial effusion into the joint is usually limited; the pain is seldom severe; the amount of joint-movement is diminished; and there is usually contraction of the limb, and sometimes partial dislocation. When suppuration occurs, there is more pain and fever. The progress of the disease is generally very chronic, extending over months or years, and allowing the patient at intervals to take moderate exercise. Exacerbations take place, however, from slight causes, or without cause; attacks of subacute or acute inflammation supervene; and sooner or later abscesses form, communicating both with the cavity of the joint, which becomes totally disorganised, and with the surface.

Brodie's 'pulpy disease of the synovial membrane' is simply an exaggerated degree of granulation synovitis, in which the subsynovial tissue becomes enormously thickened by successive attacks of inflammation,

Treatment.—The disease is most rebellious to treatment, and scarcely curable amongst the poorer classes without operation. Sometimes the diseased tissue is got rid of by suppuration; and, if the patient's strength suffice, a cure by anchylosis, probably accompanied by considerable deformity, will ensue. Generally, however, the symptoms become worse; the general health gives way from the drain of the continuous discharge; or amyloid or some other intercurrent disease kills the patient. At any time, as in a suppurating wound, pyæmic symptoms or hectic may set in.

c. Papillomatous Synovitis.— Synon.: Fimbriated disease of the synovial membrane; Papilloma, or Papillary Fibroma of the synovial membrane; Ger. *Gelenkzotten*.

This is a peculiar form of joint-disease dependent on chronic synovitis, in which numerous pedunculated bodies, cylindrical or fusiform, varying in size from a pin's-head to a large pea, project from the membrane, generally near the cartilage margins, or they may cover the entire surface. They are identical in minute structure with the synovial fringes. Some become detached, and fall into the cavity of the joint. The disease is essentially a hyperplasia of the synovial adventitia; and there may be dozens or hundreds of these bodies present in one joint. Occasionally they contain cartilage-cells, or osseous particles. The joints in the lower limb are most often affected.

Treatment.—The disease is scarcely remediable except by excision of the joint, which may be practised in those cases in which there is serious loss of function.

6. **Joints, Inflammation of, Gonorrhœal.** This disease is often called 'gonorrhœal rheumatism.' It is almost always observed in the male, very rarely affecting the female. Generally one joint, usually in the lower limb, is involved, as the knee or the ankle. It is not so common in the upper extremity. It may affect several joints in succession. It may occur at any period of a gonorrhœal or even a gleety discharge, of which the patient himself is possibly unaware. The fibrous tissues of the joint seem to be primarily engaged. Sclerotitis and inflammation of the internal layer of the cornea often coexist, but never either endo- or pericarditis.

Symptoms.—The joint affected is exquisitely tender on pressure; it is swollen rather from subcutaneous œdema than by intra-articular effusion, which is usually inconsiderable; and one side of the joint is often more affected than the other. The fever is not in proportion to the intensity of the local symptoms, the rise of temperature being slight. The course of the disease is slow and obstinate; but when cured it is not liable to return, except with a fresh attack of gonorrhœa. These characters distinguish it from ordinary rheumatism.

Treatment.—Rest, cold applications, and the internal exhibition of iodide of potassium constitute the best treatment for gonorrhœal inflammation of joint. *See* Rheumatism, Gonorrhœal.

7. **Joints, Inflammation of, Gouty.**—Gout frequently occasions synovitis, by the deposit of urate of soda in the perisynovial tissue, which excites a synovial effusion. The attacks are very acute and painful; and as they recur, the joint becomes more and more disorganised, from permanent deposits of urates in the cartilages and bone, as well as in the perisynovial tissue. The use of the joint is lost; and the 'chalk-stone,' as it is called, acting as a foreign body, sometimes produces an abscess, or an ulceration very troublesome to heal. When the collection is quite superficial, it may often be evacuated by incision with great relief. *See* Gout.

8. **Joints, Inflammation of, Strumous.**—Scrofula and tubercle are often associated with joint-diseases. Scrofulous or strumous inflammation of a joint is a vague term, but we are without a better. It is a form of chronic inflammation in ill-nourished persons—nearly always children—who live under bad hygienic conditions, and are prone to deposits of tubercle. It is observed most frequently in the knee- and hip-joints.

Anatomical Characters.—This disease generally commences in the synovial membrane, which becomes thickened, and by degrees converted into a semi-gelatinous mass of granulation-tissue, yellowish-white or pink in colour; or the disease may originate in osteomyelitis of the end of the bone. After it has existed for some time, it is difficult to determine in what tissue it may have originated, and it is of no clinical importance to do so, for in any case the later stages of the malady present similar features. The cartilages are encroached upon from their margins and from their deep surfaces by the granulations, whilst active changes occur simultaneously in their substance, similar to those already described. The ligaments soften, and all the structures of the joint become involved. Frequently small masses of necrosed bone will be found in the cancellated structure, and the granulations have a great tendency to suppurate. In the thickened synovial membrane, and also in the ends of the bones, miliary bodies, identical with tubercles, may very frequently be detected.

Symptoms.—In strumous inflammation the joint is uniformly swollen, tense, elastic, with a white glistening surface, and enlarged veins shining through the skin. The patient can usually move about until suppuration has taken place, as the pain is never very severe in the intervals of the acute attacks of inflammation which supervene from time to time. Enlargement of the lymphatic glands, or marks of strumous ulceration elsewhere are seldom wanting; whilst sooner or later a large proportion of the individuals affected by this form of joint-disease show signs of general tuberculosis. Sometimes this state precedes, but generally it follows, the local joint-affection. Inherited syphilis appears to be a predisposing cause of strumous arthritis.

Treatment.—This must be mainly directed to improving the patient's general condition. A purely local treatment, short of a complete removal of the diseased structures, is not of the least use. When the joint has become disorganised, as before described, excision should be performed before the viscera become implicated. If other organs be involved, or the local disease be too extensive, then amputation becomes imperative. When not relieved, fresh foci of suppuration form; the patient becomes more and more exhausted; or some intercurrent disease sets in. It is rare for spontaneous cure to happen.

9. **Joints, Loose Cartilages in.**—Synon.: Fr. *Corps flottants articulaires*; Ger. *Gelenkmäüse.*

Description.—'Loose cartilages' in joints may originate either from chronic inflammation, or from traumatic causes. They may be single or multiple. The knee-joint is most frequently affected, and in it the most serious symptoms are produced. These bodies may be fibrous, lipomatous, chondromatous, or osteo-chondromatous. They may be produced from polypoid growths springing from the synovial membrane in certain forms of chronic synovitis, and in arthritis deformans; and they are then usually of the fibrous or osteoid variety. Lipomatous free bodies are rare, and are derived from the subsynovial fatty tissue, being produced in a fashion analogous to the appendicæ of the great intestine.

The chondromatous and osteo-chondromatous are the largest and most important varieties of these bodies; hence the common term 'loose cartilage.' Portions of the joint-surface may sometimes become detached, as the consequence of an injury, by a process of quiet necrosis. They thus become loose in the joint. There is good reason to believe that some of these bodies may obtain nourishment from the surrounding synovial fluid, and that cartilage and even bone can be developed in them subsequently to their detachment.

Symptoms and Diagnosis.—The symptoms of loose cartilages in a joint vary very much. In some instances these bodies cause no inconvenience. In others they produce repeated attacks of excruciating pain, followed by synovitis, laying the patient up for weeks; whilst in the most severe cases the limb may become almost useless. When the knee is the joint affected, the patient experiences great insecurity in walking, the loose body from time to time becoming wedged between the joint-surfaces. The joint is thus 'locked.' The patient may suddenly fall, or faint with pain; an attack of synovitis follows; and with a frequent repetition of this process joint-disorganisation may finally result. The prognosis as regards function is always bad.

Treatment.—The treatment of loose cartilages may be either *palliative* or *radical*. The former method consists in applying support to the joint; limiting its movements; and fixing the loose body in some synovial pouch where it cannot interfere with the articular surfaces.

The *radical* method consists in excising the body—an operation, with few exceptions, almost exclusively practised upon the knee-joint. The body may be removed by a free direct incision into the joint, and squeezing the body through the wound at once. Or the indirect manner of operating may be adopted. This consists in subcutaneously incising the capsule of the joint with a long, narrow-bladed knife introduced at some distance from the articulation; forcing the body through this incision into the cellular tissue outside; and then closing the small external puncture in the skin. Three or four weeks later the 'cartilage' may be removed by a superficial incision, or left undisturbed, when it often becomes absorbed.

In appreciating the comparative value of these two plans, it may be said that the former has hitherto proved more uniformly successful *quoad* extracting the body, but that it has been more dangerous to limb and life—a danger, however, which antiseptic precautions will in future reduce to a minimum. The indirect method has been attended by a considerable number of failures in the extraction of the loose cartilage, especially if it be pedunculated; but it has hitherto proved a much less dangerous operation. The extremity should be immobilised afterwards for two or three weeks.

When some dozens of these bodies are present in a joint, many of them free, many attached, excision of the articulation is often the only remedy. This is a severe measure, and not to be lightly undertaken, in the joints of the lower limb at all events.

10. Joints, Nervous Affections of.—Synon.: Hysterical joint; Neuralgia of Joints; Arthralgia; Fr. *Arthralgie hystérique*; Ger. *Gelenkneurose*.

Description. — *Hysterical* affections present symptoms simulating real joint-disease so closely, that the strongest therapeutic measures have often been exerted, though in vain, for their cure. Prolonged immobilisation, blistering, the actual cautery, resection, and even amputation, have been practised upon joints in which there was not a trace of organic disease.

The existence of hysterical affections of joints is denied by some; but assuredly they do occur; and most often in young women, well-to-do in life, with disordered catamenia. The same thing occurs, but less frequently, in young men. The disease is not witnessed under the age of puberty. The hip and knee are the joints principally complained of—most frequently the latter. An all-important feature of a hysterical joint is that, while the local symptoms may be intense, the general symptoms are either absent, or in no sort of proportion to the local.

A special character of this disease is that deep pressure is often less painful than superficial pressure; and that the pain and tenderness are vague, shift from one point to another, and will disappear at a given spot when the patient's attention is directed elsewhere. There is pain on movement, but of an indefinite character, and not so limited or localised as in real disease. Nocturnal startings do not occur; the patient may enjoy uninterrupted sleep for hours. There is never a continuous rise of temperature, either general or local; the co-relation of the symptoms is not the usual one; the function of the joint is much more interfered with than the other features of the disease present would appear to justify. There is an exaggerated fear of examination; and the *facies hysterica* is often well-marked. There may be thickening around the joint, and even marked synovial effusion into it; but these conditions are passive in character, and generally due to the treatment employed. The limb is wasted and consequently weak, but never to the same extent as in real joint-disease. Exacerbations occur at the menstrual period. A careful inquiry should be made into the history and antecedents of the case. An examination under chloroform will often afford important evidence; and the patient's symptoms will be improved afterwards by the movements then practised on the joint.

Neuralgic pain in the articulations may arise under different circumstances. It may be the referred pain, unattended by local lesion, which is so frequent in the knee in cases of hip-joint disease. Neuralgic pains in various joints are observed in the preliminary or early stages of chronic myelitis. In the first stage of locomotor ataxy the knee may be affected by severe neuralgia when the disease is low down in the cord; or the shoulders when it is at a higher point. Lastly, so called neuralgia of a joint may really indicate some obscure lesion, as chronic inflammation of the bones entering into the formation of the articulation.

Treatment.—The methodical exercise of an *hysterical* joint is as plainly indicated as rest is imperative in a case of organic disease. The bowels should be regulated, as also the menstrual flow. Assafœtida, iron, and quinine are most important remedies; and healthy mental and moral influences are valuable adjuncts. 'Get up and walk' is a good prescription in many such cases. Very careful and repeated examination should always be made, to exclude any possible form of chronic inflammation, before pronouncing a joint to be hysterical. It must not be forgotten, however, that after slight injuries which produce some inflammatory symp-

toms, those of hysterical joint may supervene, and persist long after all traces of organic disease have disappeared.

The treatment of *neuralgia* connected with a joint will necessarily vary with its cause. *See* NEURALGIA.

11. Joints, Rheumatic Arthritis of, Chronic.—SYNON.: Osteoarthritis; Fr. *Arthrite avec usure des cartilages*; *Arthrite sèche*; Ger. *Altersabschleifung*.

ÆTIOLOGY AND PATHOLOGY.—The number of names that have been applied to this disease betrays the obscurity enveloping its pathology. In nature it is, however, essentially a senile degeneration, preceded by chronic inflammation; and is, in part, perhaps the result of wear and tear of the joint. It is most common in hard-working people, exposed to the influence of wet and cold, and in the aged. One or many joints may be affected; generally the fingers, the toes, the hip, and the knee. It may be set up by injury, such as a sprain, dislocation, or fracture; or it may arise without known cause. It is difficult to say which tissue is primarily at fault, but sooner or later all become involved. The synovial membrane inflames; papillary outgrowths form upon it; the cartilage swells; and the ends of the bones enlarge. After a time the quantity of synovial fluid diminishes; the joint-friction increases; the cartilages are rubbed away at the surfaces of contact; and afterwards the bone itself, which becomes denser by interstitial deposit, disappears. The surface is eburnated, and marked with striæ produced by friction; whilst deposits of new bone, which may often be felt externally, form around the margins of the joints, so that the area of its surfaces becomes greatly increased.

SYMPTOMS.—The symptoms of chronic rheumatic arthritis chiefly consist in constant pain, of a dull aching character, and worse at night, Motion becomes more and more difficult and painful as the disease advances; but anchylosis never occurs. Rough crepitus is felt both by the patient and the surgeon when the joint is moved. *See* RHEUMATIC ARTHRITIS.

TREATMENT.—The treatment of rheumatic arthritis can only be palliative, and consists in the use of warm douches and other warm applications, and the administration of iodide of potassium internally. The disease is incurable.

12. Joints, Serous Effusion into.—SYNON.: *Hydrops articuli*; *Hydarthrosis*; Fr. *Hydarthrose*; Ger. *Gelenkwassersucht*.

This is a form of chronic serous synovitis, in which there are no obvious inflammatory symptoms. The joint sometimes becomes greatly distended; the ligaments are stretched; and in consequence there is a sensation of tension and feebleness in the articulation. The knee and elbow are most frequently attacked; and the disease is often associated with a gouty or rheumatic diathesis, or with rheumatoid arthritis. It is very difficult to cure. The joint may be punctured and the fluid drawn off, or, still better, it may be injected and thoroughly washed out with iodine (equal parts of the compound tincture and water) or a carbolic acid ($2\frac{1}{2}$ to 5 per cent.) solution; but relapses are common.

13. Joints, Syphilitic Disease of.—This disease may originate in children, in the form of a suppurative ostitis at the junction of the epiphysis and diaphysis. Other signs of congenital syphilis will help to establish the diagnosis. The disease runs a rapid course, and the joint is frequently destroyed. In the adult a chronic plastic synovitis, due to gummatous infiltration of the perisynovial tissue, or of the bone and periosteum, is the more common form. There is very little fluid effusion within the joint, but considerable impairment of mobility is produced by the thickening outside it. The progress of the disease is slow and painless, except at night or on motion. The history of the case; the presence of traces of syphilis elsewhere; and the effects of treatment, will help in establishing the diagnosis. The internal administration of mercury and iodide of potassium, combined with local pressure by means of strapping with mercurial plaster, speedily effects a marked improvement and cure.

WILLIAM MACCORMAC.

JUGULAR VEINS, Physical Signs in connexion with. — The principal physical signs in connexion with the jugular veins are distension, pulsation, and venous hum. *See* PHYSICAL EXAMINATION.

K

KELOID.—SYNON.: Fr. *Chéloïde*, *Kéloïde*; Ger. *Keloid*.—*Keloid* and *cheloid* are two words resembling each other in sound, and sometimes used indiscriminately, but differing altogether in origin and signification. *Keloid* is derived from κηλὶς, a mark or blemish; whilst *cheloid* derives its origin from χηλὴ, a crab's claw. The disease which we now recognise as cheloid was first described by Alibert under the name of *kelis*, with the synonyms, *cheloide* and *cancroide*, and is therefore sometimes referred to as the 'kelis of Alibert' (*see* CHELOID). The term keloid has, however, been applied by Addison to a blemish of the skin, resulting from a fibrous degeneration of the derma allied with scleriasis; hence the use of the term *kelis Addisonii*. Both diseases are really fibromata; but one, namely cheloid, is a tumour, while the other, kelis, is flat, and often resembles a cicatrix. There is another obvious difference between them: cheloid is restricted to the derma, whilst kelis follows the subcutaneous connective-tissue to the deeper parts of the body.

The early dermatologists described kelis under the name of *morphœa*, and by that name it is still distinguished by some modern writers.

ERASMUS WILSON.

KERATITIS, or KERATODEITIS (κερας, a horn, the cornea).—Inflammation of the cornea. *See* EYE AND ITS APPENDAGES, Diseases of.

KERION (κηρίον, a honeycomb).—A term applied to a pustular folliculitis of the scalp. The inflamed skin occurs in the form of one or several blotches of a deep red colour, prominent, and dotted over with yellow spots—the apertures of the follicles, from which the hair has been expelled, and which exude a copious muco-purulent fluid. The yellow spots are converted into hollows by the tumefaction of the framework of inflamed skin, and, no doubt, thereby suggested the idea of a honeycomb, whilst the muco-purulent secretion might in like manner be compared to honey. Another feature of the disease is the elimination of the hair from the inflamed follicles, and the subsequent baldness of the affected part. Kerion is sometimes associated with tinea capitis. *See* SKIN, Diseases of; and TINEA.

ERASMUS WILSON.

KIDNEYS, Diseases of.—SYNON.: Fr. *Maladies des Reins*; Ger. *Nierenkrankheiten.*—The kidney is subject to a number of diseases, which will be considered in the following pages in alphabetical order. At the outset, however, it will be convenient to present an outline of the abnormal phenomena to which these affections may give rise.

SUMMARY OF SYMPTOMS.—The facts upon which the diagnosis in diseases of the kidneys is founded, are of three classes, namely;—A. **Abnormal local conditions**; B. **Abnormalities of the urinary secretion**; C. **Abnormalities in other parts of the system, secondary to the local phenomena.**

A. **Abnormal local phenomena.** — These may be:—

a. Subjective. The patient may experience pain or uneasiness in the region of the kidney, on one or both sides; and abnormal sensations may be also referred to the ureter, the bladder, or the urethra. The pain may be influenced by attitude or by exertion; and be either constant, paroxysmal, or periodic. It may be aggravated, relieved, or unaffected by pressure.

b. Objective. Examination of the abdomen and pelvis, by means of palpation and percussion, may reveal the presence of a tumour connected with the kidney. The tumour may be solid or fluid; uniform or lobulated. Tumours of the kidney may generally be made out by palpation, and especially by tilting with the one hand the mass forwards from the lumbar region, upon the fingers of the other hand applied in front. In some cases the absence of the kidney from its normal position may be ascertained by percussion in the lumbar region. By careful observation of the relative form of the two sides at the back and in front, either the presence of tumour, or the absence of the organ, may be rendered distinct.

B. **Abnormalities of the urinary secretion.**—*a.* The urine may be altered in *quantity.* It may be increased, as in waxy degeneration of the kidney, or in advanced stages of cirrhotic and inflammatory Bright's disease; or diminished, either from obstruction to its escape, or from failure of secretion. The conditions leading to obstruction to outflow are certain diseases of the urethra, prostate, bladder, or ureters; the last-named inducing suppression only where both the ducts are simultaneously occluded, or where one kidney having been previously destroyed, the ureter of the other side subsequently becomes affected. The impaction of calculi, and the pressure of new-formations are the chief causes of these obstructions. The conditions leading to diminution or failure of secretion are the pyrexial state; obstruction of uriniferous tubules, as by inflammatory products; long-standing passive congestion, as in cardiac disease; and probably some forms of altered innervation.

b. The urine may be altered in *colour*, as from the presence of blood, pus, bile, purpurin; or of substances introduced into the system, such as logwood, rhubarb, senna, tar, and carbolic acid.

c. The *specific gravity* may be altered, being much raised when the proportion of water is small, or when an excessive amount of sugar or of urea is being eliminated, or when a large proportion of blood or of albumin is present. It is diminished whenever the proportion of water is excessive, or the elimination of urea diminished. It is thus an important feature of renal disease. In determining the specific gravity it is important to remember that, when the specimen has stood for some time, it may vary in different parts of the same column of fluid; that it varies with the temperature, being lower in warm than in cold fluid; and further that it varies at different times of the day, in relation to the state of the digestion.

d. The *reaction* of urine varies from the slightly acid standard of health, by being either too acid or alkaline. The acidity may be excessive when the urine is passed, or may become increased after it has been voided, in consequence of the acid fermentation. It may be alkaline when passed, from the presence either of fixed alkali or of ammonia. The ammonia results from decomposition of urea, and this change constantly occurs in urine which has been kept and allowed to decompose.

e. Albumin is a common morbid constituent of urine, either temporary or permanent. Temporary albuminuria may be artificially produced by the ingestion into the stomach, or by subcutaneous injection, of raw albumin of egg; and it sometimes results from derangement of the digestion, due to the use of indigestible articles of food. It occurs in certain blood-diseases, such as scarlet fever, erysipelas, diphtheria, and acute yellow atrophy of the liver, and is probably due to the irritation of the kidneys by the poisons proper to these maladies. It also occurs in some cases where fever is high and persistent, and is then to be explained by alteration of the condition either of the vascular walls, of the renal cells, or of the innervation of the kidneys. It also occasionally results from the use of certain drugs, such as turpentine and cantharides; certainly sometimes

from nervous affections, such as exophthalmic goître, epilepsy, and injuries to or organic disease of the brain. Permanent albuminuria is met with in all the forms of Bright's disease; most abundantly in the inflammatory form; to a less extent, but constantly, in the albuminoid; to a still less extent, and sometimes altogether absent, in the cirrhotic variety. It also results from passive congestion of the kidneys, due to cardiac disease or other cause; as well as from suppurative nephritis and other diseases of the kidney, and from pyelitis. The ordinary albumin of the blood-serum is the form which usually appears in the urine. Now and then it is found, especially in the course of or after acute febrile diseases, that a variety of albumin occurs in the urine which is unaffected by heat and nitric acid, but which becomes coagulated by alcohol. This may either be from alteration of the substance itself, or from the presence of some material which interferes with the ordinary chemical reaction. *See* ALBUMINURIA.

f. Urea is diminished in quantity wherever there is destruction of the renal epithelium, as in the different forms of Bright's disease, especially the cirrhotic and inflammatory varieties.

g. The *physical* and *chemical* characters of the urine are often much modified by conditions other than diseases of the kidneys themselves, and abnormal ingredients may be present, such as sugar or bile, but these alterations do not come within the scope of the present article.

h. Deposits are also frequently present in the urine, which are due to various causes apart from renal disease, namely, urates and uric acid, oxalate of lime, phosphates, cystine, xanthine, tyrosine, and leucine. Organic deposits are important in many affections of the kidney or its pelvis. In the first place the *epithelium* from the latter may be present in more or less abundance. *Pus* appears as a fine granular yellowish deposit, which becomes viscid and transparent on the addition of liquor potassæ. In ammoniacal urine it is sometimes found that the pus-cells have undergone this change within the bladder. Pus may be derived from the pelvis of the kidney, or from the kidney-substance itself. Deposits very similar in general appearance to pus are sometimes seen in cases of scrofulous kidney, but the microscopic appearances are different, the corpuscles being altered, and often associated with fibrous tissue. *Cancerous* deposits, showing distinct cancer-cells, are also sometimes met with. The presence of *blood* gives the urine a smoky, pinkish, or actually bloody appearance. *See* HÆMATURIA.

Tube-casts are sometimes so numerous as to constitute a deposit quite visible to the naked eye. These casts are solid moulds of the uriniferous tubules, sometimes formed within the free lumen of the tube, but far more frequently within the basement-membrane, thus including the more or less altered epithelium. The simplest form of tube-cast is the hyaline, a clear structureless cast. Blood-casts are common, containing distinct red corpuscles. Epithelial and desquamative casts are opaque and granular, the granularity being due for the most part to the abundance of altered epithelium in their substance. Fatty casts are those which exhibit evidences of fatty degeneration of the epithelium. *See* BRIGHT'S DISEASE; CASTS; and URINE, Morbid Conditions of.

C. Symptoms occurring in other parts of the body.—Very important symptoms occur in connection with renal diseases, affecting the organs of circulation and of digestion, the nervous system, and the skin; but these are for the most part associated with Bright's disease. *See* BRIGHT'S DISEASE; and URÆMIA.

The several diseases of the kidney will now be indicated, and those will be discussed which are not described under special headings in other parts of the work.

1. Kidney, Abscess of.—SYNON.: Renal abscess.—This is often used as a generic term including any accumulation of pus in connection with the kidney, whether in the substance of the organ, in its pelvis, or even around it. Strictly, it applies only to a collection of matter resulting from suppuration in the kidney-structure itself. *See* Kidney, Inflammation of Pelvis of; Kidney, Suppurative Inflammation of; PERINEPHRITIS; and SURGICAL KIDNEY.

2. Kidney, Acute Atrophy of.—DEFINITION. This is a rare disease of the kidney, consisting in rapid exudation into the cells of the organ, followed by fatty degeneration and disintegration; caused by unknown conditions; characterised by sudden occurrence of copious albuminuria, with very numerous tube-casts, and frequently marked uræmic symptoms; and resulting apparently invariably in death.

ÆTIOLOGY.—The causes of this affection are unknown, but it appears probable that it depends upon some form of blood-poison, the disease being frequently associated with acute atrophy of the liver. In most cases it would appear to follow the hepatic disease; in some it precedes it. It is much more common in the female sex than in the male; and is most frequent during pregnancy and after childbirth.

ANATOMICAL CHARACTERS.—There are two stages in the progress of this disease, namely, (1) that of exudative infiltration and enlargement; (2) that of disintegration and atrophy. In the first stage the organ is enlarged, not markedly congested, the capsule strips off readily, the substance is flaccid, the cortical substance is swollen, the individual tubules are enlarged and white. On section the vessels are found mostly empty of blood, being compressed by the diseased tubules. The tubules are occupied by dense opaque material; and the individual cells are swollen and granular, their nuclei being hidden by molecular cell-contents. The tubules of the cones, as well as those of the cortical substance, are frequently affected. Many of the cells also are in a state of fatty degeneration, or broken down even at this stage. In the more advanced stage the organ is smaller than natural, and its capsule appears wrinkled. The kiddey is pale and flaccid. When cut into there escapes a quantity of débris, often containing oil-globules, quite visible to the naked eye. The stroma is intact, and sections can easily be made with a Valentin's knife. The sections show that many of the tubules are denuded of epithelium, and that the shrinking of the organ results

from this disintegration. It is easy to find different tubules and cells in various stages of transformation, some showing the early stage of cloudy swelling, others the stage of fatty transformation, and others the disintegrating, almost deliquescent condition. The friability of the cells is quite extraordinary, the weight of a thin covering glass often sufficing to reduce them to molecular débris.

It will be observed that the changes, both in the organ and the individual cells, exactly correspond to those met with in acute atrophy of the liver.

Symptoms.—The symptoms characterising this affection have not yet been very fully studied. Diminution of urine, copious albuminuria, with deposit of casts corresponding to the changes in the kidney, are probably the chief renal symptoms. A tendency to hæmorrhages, jaundice, and uræmic nervous affections, and the series of symptoms proper to acute atrophy of the liver, are also observed.

Diagnosis.—There is probably no disease with which this is very liable to be confounded.

Prognosis and Treatment.—The prognosis must be unfavourable; and no treatment can be of any avail.

3. Kidney, Albuminoid Disease of. *See* Bright's Disease.

4. Kidney, Anomalies of.—The kidneys may present three kinds of anomaly, namely:—1. In number. 2. In form. 3. In situation. Only the first of these will be referred to here.

Anomalies in Number.—Sometimes one kidney, with the corresponding ureter, is entirely absent. In such cases the organ which is present is much above the normal size. There is generally no symptom present during life, but diseases of the pelvis of the kidney or the ureter are made more formidable in persons so affected, than in those normally developed. Occasionally one or more supernumerary kidneys are present. *See* Kidney, Malformation of; and Kidney, Malpositions of.

5. Kidney, Calculus in. *See* Renal Calculus.

6. Kidney, Cancerous Disease of. *See* Kidney, Malignant Disease of.

7. Kidney, Chronic Atrophy of.—This condition of the kidney arises under a variety of circumstances, but specially as a consequence of hydronephrosis, and of the different forms of Bright's disease. In hydronephrosis the atrophy commences in the cones, and spreads to the cortical substance. In all the forms of Bright's disease it commences at the surface and spreads inwards. In hydronephrosis atrophy is a result of the pressure of the renal secretion, as it accumulates in the dilated pelvis and within the tubules. In inflammatory Bright's disease it is due to interstitial changes, and the gradual absorption of the contents of the occluded uriniferous tubules. In cirrhotic Bright's disease it is a consequence of the contraction of the hypertrophied fibrous stroma, and the consequent destruction of vessels and secreting structures. In the waxy or albuminoid form it is due to the molecular absorption of the hyaline material and altered cells which occupy the uriniferous tubules, as a consequence of the degeneration proper to the vessels.

Anatomical Characters.—Although really atrophied, the hydronephrotic kidney appears large, and may form a mass several times the size of the normal kidney. It is lobulated on the surface, and may often be seen to be little more than a group of cysts containing watery fluid. In the earlier stages no change is observed, except flattening of the cones; in the later the cortical substance also is more or less wasted. This condition is usually seen only on one side, the other kidney being natural, or somewhat hypertrophied.

Atrophy from inflammatory Bright's disease is rarely far advanced when the fatal result occurs. Both kidneys are affected, and usually to the same extent. The capsule strips off readily. The surface presents a finely granular appearance. On section, the cortical substance is found relatively diminished. Many of the tubules are occupied by sebaceous-looking material. Many of them are diminished in size, and irregular in outline from absorption of their contents. The stroma is relatively increased; the vessels are little altered.

In the cirrhotic form the atrophy is often more advanced, and is commonly equal, or nearly so, on the two sides. The capsule is adherent, the surface granular and uneven. On section, the cortical substance is diminished, and it often contains many cysts. On microscopic examination the fibrous stroma is found markedly increased, many of the tubules and vessels are destroyed, while the smaller arteries are thickened.

In the albuminoid form the kidneys have in some cases been found greatly and nearly equally diminished in size. The capsule strips off readily; the surface is finely granular. On section the cortical substance is found diminished, the degenerated Malpighian bodies remaining singularly prominent, especially towards the surface, the stroma appearing relatively somewhat increased, and the hyaline contents of the tubules in process of absorption.

Symptoms.—No definite group of symptoms indicate the existence of atrophy. Those met with in the atrophic stages of the different affections are described under each disease.

Partial Atrophy of the Kidney results from embolism, new-formations, and other like causes; and is in many instances unattended by symptoms.

8. Kidney, Cirrhotic. *See* Bright's Disease.

9. Kidney, Congestion of. *See* Kidney, Hyperæmia of.

10. Kidney, Cystic Disease of.—Definition.—A chronic morbid state of the kidney, caused by conditions not fully ascertained; characterised in some cases by no symptoms, in others by the presence of tumours, and by symptoms resembling those of the cirrhotic form of Bright's disease; resulting in permanent change; and not amenable to treatment. The formation of cysts in the kidney may be unim-

portant, either from the small number of cysts, or from the co-existence of much graver disease of the kidney; but it may constitute a serious disease.

Ætiology.—Nothing is known as to the causes of cystic degeneration. It may be congenital, or may come on during adult life. The mode of origin of the cysts appears to be from the dilatation above obstructed points in the course of uriniferous tubules, or at their points of origin in the Malpighian bodies. Sometimes the cysts are new formations in connection with epithelium; and sometimes they arise from the fibrous stroma of the organ.

Anatomical Characters.—Renal cysts vary greatly in size, from minute, almost microscopic, cavities, to spaces capable of holding several pints of fluid. The true cystic kidney is large; its surface is uneven, and in colour resembles a piece of conglomerate. The capsule strips off, but often with some difficulty. On section its substance is found replaced by multitudes of cysts, scarcely any proper tissues remaining. The contents are sometimes watery, sometimes contain urinary constituents, sometimes are tinged with blood, and sometimes are gelatinous or colloid.

Symptoms.—In many cases cystic disease of the kidneys is unattended by any symptoms; and even when the disease is extensive and severe there are, as a rule, no constitutional symptoms until the case draws near its termination. Among local signs the most important is enlargement of the organs, which may sometimes be made out by means of palpation and percussion, in cases which are advanced, and in emaciated subjects. Both organs are generally equally enlarged. The urine is secreted in natural or in excessive quantity; its specific gravity is low; and it contains albumin, and sometimes blood. The termination of these cases is not unfrequently abrupt, with uræmic convulsions and coma.

Diagnosis.—The points which are of importance are the presence of bilateral tumour; with copious discharge of urine of low specific gravity, or containing albumin.

Prognosis.—The prognosis is always unfavourable.

Treatment.—Treatment can be directed only to the relief of symptoms.

11. Kidney, Dropsy of.—This is a synonym for hydronephrosis, in which urine, more or less altered, accumulates in the renal pelvis, as the result of obstruction of the ureter. *See* Hydronephrosis.

12. Kidney, Embolism of.—The impaction of emboli in the branches of the renal arteries gives rise to various lesions, of which the most common is the hæmorrhagic infarction; next to this inflammation and secondary abscesses; and more rarely gangrenous inflammation. These affections often do not manifest themselves during life by any distinct symptoms; or their existence may be revealed by sudden albuminuria and hæmaturia, and sometimes by general constitutional disturbance and local pain.

Ætiology.—The chief cause of renal embolism is disease of the valves of the heart. The emboli may be composed of coagulated fibrin; or of fragments of the tissue of the valve, which have been separated by ulceration. More rarely embolism is caused by fibrin which has coagulated between the meshes of the fleshy columns of the heart, or by coagula which have formed on the roughened inner coat of arteries. Among the remoter causes are those of endocarditis and endarteritis. This, in so far, vindicates the name which Rayer applied to these infarctions—'rheumatismal nephritis.'

Anatomical Characters.—1. *Of hæmorrhagic infarction.*—This may, for convenience, be described as passing through three stages:—(1) that of red consolidation; (2) that of fawn-coloured transformation; and (3) that of absorption or atrophy. The form of the masses is usually conical, or, as seen on section, wedge-shaped, the base being towards the surface. At first a patch is deeply congested, and presents a dark red colour. On microscopic examination the vessels are found congested, many ruptured; and blood is extravasated into the tubules. In the second stage this redness has passed away; a buff or fawn-coloured mass represents the red patch of the earlier stage. On microscopic examination the cells of the tubules are found to be destroyed, and within them, as well as in the stroma, blood-pigment may be found. In the third stage there is commonly a depression of the surface of the organ; and, on section, what had been the conical patch is represented by a fibrous cicatrix.

2. *Of the abscesses.*—In certain cases, especially in the course of pyæmia, emboli lead to abscesses. Throughout the organ such abscesses exist, and may be traced in various stages, which might be described as those of red consolidation, of ashy-gray consolidation, and of suppuration. In this condition the clot is not to be found at the apex of the cone of disease, but imbedded within it. Between the simple infarction and the abscess there is an intermediate form—a certain degree of suppuration occurring at the margin of the affected area.

3. *Of gangrenous patches.*—Very rarely it appears that, in consequence of the impaction of an embolus, gangrene of the affected district occurs, with more or less suppuration.

Symptoms.—The symptoms of the embolic infarction are often very indistinct, but the condition may sometimes be diagnosed. When valvular disease of the heart or extensive calcareous affection of the arteries exists, and when in addition to this sudden albuminuria or hæmaturia appears, with some degree of fever, and pain in the region of the kidneys, there is every reason to conclude that an embolus has been impacted. This condition is rarely one of importance in the case, for much graver maladies coexist with it. The occurrence of abscess in the kidney may sometimes be surmised when sudden albuminuria or hæmaturia becomes superadded to the other symptoms of pyæmia. Gangrene of the kidney or a portion of it is not likely to be capable of diagnosis during life.

Diagnosis.—The diagnosis of renal infarction turns upon the points above referred to. It is important to distinguish it from Bright's disease, and from passive congestion. From the former it is distinguished by the suddenness of

the onset, the shortness of its duration, the absence of dropsy, and the presence of cardiac or vascular disease; from the latter by the suddenness of its development, and by the absence of signs of stasis in other organs.

Prognosis.—The prognosis in cases of infarction is favourable so far as the kidneys and their functions are concerned, but unfavourable in this respect that there is a tendency to the impaction of emboli in other more important parts, particularly in the brain.

Treatment.—No special or particular treatment can be directed in this condition.

13. Kidney, Fatty Disease of.—Definition. A chronic affection of the kidney, consisting in simple fatty degeneration of, or infiltration into, the renal epithelium, without inflammation; characterised by no symptoms as yet clearly ascertained.

Ætiology.—Fatty kidney results in some cases from long-continued exhausting disorders; from senile marasmus; from starvation; from poisoning with phosphorus; and perhaps from excessive indulgence in fatty food.

Anatomical Characters.—The organs are of about the natural size, their surface is smooth, and the capsule strips off readily. There is no congestion, and scarcely any stellate veins are visible. The organ is more soft and flexible than natural, and the surface is mottled with numerous deposits of sebaceous-looking material. On section the relative size of the cortical substance and the cones is seen to be preserved; and beyond a general pallor there is no change except the abundant deposition of sebaceous-looking material, mostly in the tubules of the cortical substance, but also in those of the cones.

On examining a section with a low power of the microscope, the characteristic fatty opacity is well-marked, and by careful scrutiny it may be generally made out that the fatty material is not in the canal of the tubule, but within the epithelial cells. The Malpighian bodies, the vessels, and the stroma, under a higher power, appear natural; and in transverse section of the tubules, a clear lumen may be made out. It will thus be observed that there is no inflammatory desquamation of the cells, nor exudation filling up the lumen of the tube.

Symptoms.—Little is known of the clinical features of this affection. But the quantity of the urine appears to be diminished. There is certainly no albuminuria, and apparently no other important change in its composition. Dr. Lang, of Dorpat, has shown that a little free oil is sometimes found in the urine.

Diagnosis.—It is scarcely possible to diagnose this affection with certainty; but diminution of the urine, without albuminuria, and with the presence of oil in the urine, especially if associated with the signs of fatty liver, and with any of the known causes of fatty degeneration, may lead to the establishment of the diagnosis.

Prognosis.—The renal affection is not generally an important element in the prognosis, other conditions of more importance being present.

Treatment.—General tonic treatment, and the removal of the cause when known, are the only indications.

14. Kidney, Gouty.—This is a form of contracted granular kidney, occurring in gouty subjects, and attended with the deposit of urates in the renal tubules. *See* Bright's Disease; and Gout.

15. Kidney, Granular.—A synonym for a chronic form of Bright's disease, where the kidney presents a granular appearance. *See* Bright's Disease.

16. Kidney, Hæmorrhage in connection with.—Blood may escape into the substance of the kidney, as the result of embolism or injury; into the tubules, giving rise to blood-casts; or into the renal pelvis, especially from injury to the mucous lining by calculi. The only diagnostic indication of this event is the presence of blood in the urine, intimately mixed with it, or sometimes in clots. A coagulum of blood may block up the ureter. *See* Hæmatinuria, Paroxysmal; and Hæmaturia.

17. Kidney, Hydatid Disease of.—Definition. — A chronic parasitic disease of the kidney, caused by the reception into the system of the ova of the Tænia echinococcus, and the development in the kidney of the corresponding cystic form; consisting in the formation of hydatid cysts—'echinococcus hominis'—in the substance of the organ; characterised in some cases by no symptoms, in others by renal tumour, or by the discharge of cysts with the urine, after symptoms resembling those of renal calculus; and resulting sometimes in recovery, sometimes in death, either by perforation into the lung, intestine, or other part, or by suppuration.

Ætiology.—The tape-worm form is the Tænia echinococcus, which inhabits the intestine of the dog. The frequency of hydatid-disease is determined by the frequency of the occurrence of the tape-worm in the dogs, and by the habits of the people. It is common in Iceland, in Egypt and in South Australia. In England it is not common; in Scotland it is very rare. *See* Hydatids.

Anatomical Characters.—The affected organ is enlarged, sometimes greatly. It is often connected by adhesions to neighbouring parts. A globular tumour projects from the surface, and extends into the substance of the kidney, inducing corresponding atrophy. The cyst has an outer covering of fibrous tissue derived from the organ; and an inner coat—the cyst proper, which may be barren, that is, devoid of daughter-cysts, or may contain within it numerous smaller cysts and processes growing inwards from the walls, containing scolices which may give origin to the corresponding tape-worm. In either case the cyst-wall is somewhat tensely expanded by a clear liquid, rich in chloride of sodium. The cyst enlarges gradually, and may burst in various directions, but most frequently into the pelvis of the kidney, or into the lungs and bronchi. Sometimes suppuration of the cyst occurs, and accordingly one finds on *post-mortem* examination the remains of a shrivelled and sunken cyst, with caseated contents, in which are imbedded remains of daughter-cysts and hooklets from the scolices.

Symptoms.—The course of hydatid-disease of the kidney is always chronic. It may be pro-

longed for many years. The advance is insidious. Attention is sometimes drawn, first to the presence of a tumour, sometimes to the evidences of its rupture. When rupture takes place into the pelvis of the kidney, daughter-cysts passing along the ureter give rise to symptoms resembling those of renal colic; but the discharge of the cysts, and the results of the microscopic examination, reveal the true cause of the irritation. After such a discharge the cyst may atrophy; sometimes it happens that a second or even a third discharge occurs after a shorter or longer interval. When the discharge is by the lung, pain and cough occur, due to irritation of the pleura. Then the expulsion of the hydatids takes place; sometimes this also results quite favourably. The special features of a hydatid tumour are its globular form and its elasticity. When suppuration occurs, fever supervenes, attended with local pain.

Diagnosis.—The diagnosis of hydatid of the kidney depends upon the presence of a tumour of a special kind; and is made certain by the discharge of cysts or hooklets.

Prognosis.—The prognosis is always doubtful.

Treatment.—Medicine is of no avail. The best treatment is the removal of the fluid contents of the cyst by aspiration. When such removal is effected the parasites die, and the cyst shrivels up.

18. **Kidney, Hyperæmia of:**—Definition. An acute or chronic affection of the kidney, consisting in active or passive congestion of its vessels, with secondary changes; characterised by the appearance of albumin, and sometimes of blood and of hyaline tube-casts in the urine, the quantity of urine being generally diminished, and its specific gravity natural; resulting in recovery if the cause be removed, but in the passive form commonly continuing or recurring till the fatal result is induced, partly by the original, and partly by other causes.

Ætiology.—Active congestion, that is congestion due to increased influx of arterial blood, may be caused by inflammation; by various blood-poisons, such as those of scarlet fever, measles, typhus; and by some medicinal substances, such as cantharides, turpentine, cubebs; also probably by agencies which paralyse the muscular fibres of the small arteries—as is sometimes seen in the course of exophthalmic goître—or which increase the blood-pressure in the renal arteries. Passive congestion, which implies congestion due to hindrance to the efflux of venous blood from the organ, may be caused by any obstruction to the circulation. It is most commonly met with in cases of cardiac disease, where the right chambers of the heart are dilated. It also results from such diseases of the lungs as are followed by dilatation of the right side of the heart—for example, emphysema. It also sometimes arises, though much more rarely, from obstruction in the course of the inferior vena cava, or in the renal veins, as from pressure of aneurismal or other tumours, or from the formation of a thrombus.

Anatomical Characters.—In the *active* form of renal hyperæmia, the anatomical changes are probably less marked after death than during life. The kidneys are generally of fully the normal size; the capsule strips off readily; and the surface is smooth. On section the vessels are found congested; the Malpighian bodies frequently standing out prominently, being distended with blood. The vessels of the cones are also overfilled. More or less evidence of inflammatory change is to be found in the tubules, the epithelium being granular and opaque, and the lumen of the tubules, especially those of the cones, being filled up with coagulated fibrin. Blood is sometimes found extravasated into the convoluted tubules. The stroma is unaltered. Sometimes there is congestion of, or even extravasation into the mucous membrane of the pelvis of the kidney and of the ureter. In *passive* congestion the anatomical changes are more marked, and vary with the duration and intensity of the affection. In the slighter forms, or in those of short continuance, the kidney is of fully the natural size; its capsule strips off readily; the surface of the organ is smooth; and there is evidence of congestion. On section, the congestion is seen to occupy the veins and the Malpighian bodies; sometimes there are evidences of extravasation of blood; and sometimes fibrinous coagula are found in the tubules.

In the more chronic forms, although the capsule strips off readily, the surface is somewhat uneven; congestion is still marked on the surface, but scarcely so distinctly as in the earlier stage. On section the organ feels firmer than natural; it is in a condition which may be best described by the term induration. Its small veins and Malpighian bodies are dilated and full of blood; the fibrous stroma is relatively increased, especially towards the surface of the organ; some of the tubules are wasted, some are blocked up with exuded material, and some exhibit evidence of disintegration and fatty degeneration of the epithelium. The condition of the stroma thus approaches that of cirrhosis of the kidney; the condition of the tubules approaches that of inflammation. There is no definite boundary line between the conditions anatomically; still the combination of the changes confirms the inference which must be drawn from the study of the clinical history, that these hyperæmic changes, though approaching to, are not identical with the processes properly included under the term 'Bright's disease.'

Symptoms.—The symptoms of *active congestion* are the presence of albumin in the urine, occasionally accompanied by hyaline tube-casts, and sometimes by blood in greater or less quantity. It occurs commonly as a transient, or occasionally, as a recurring condition, and unless when it betokens a commencing inflammatory action, is rarely of much practical importance.

In *passive congestion* albuminuria is again the leading symptom; the urine is generally somewhat reduced in quantity, of about normal specific gravity, often of acid reaction, depositing urates. The amount of urea is little below the normal. Tube-casts are usually scanty, and may be wanting; when present they are hyaline or sometimes bloody, and occasionally contain altered epithelium. The other symptoms are those of obstruction to the circulation; occlusion of, or pressure on, the veins; disease of the

heart; emphysema of the lungs; and general dropsy.

Diagnosis.—The question relating to diagnosis, which is of most practical importance, lies between hyperæmia and inflammatory Bright's disease. In making this distinction, the points to which we have to attend are the general condition of the patient, in respect to the possible causes of such an affection, the presence of cardiac or pulmonary disease, or of venous obstruction. In congestive affections the urine is scanty, as it often is in Bright's disease, but it is of high colour, of natural specific gravity, and rarely deposits blood, renal epithelium, or tube-casts.

Prognosis.—The prognosis depends entirely upon the conditions inducing the congestion. In the active form it usually rapidly subsides; in the passive form, it is persistent, or at best, if temporarily got rid of, is almost sure to recur.

Treatment.—When the renal congestion is very intense, dry cupping, local blood-letting, the hot air or the warm vapour bath, or warm applications over the kidneys, may be indicated; but the treatment is mostly that of the diseases which are inducing the congestion. Thus, in the case of cardiac disease digitalis and iron, in the case of pulmonary disease digitalis with squill, and if necessary, a little blue pill or carbonate of ammonia, are indicated. The general management should be that proper to the obstructive disease which has induced the congestion.

19. Kidney, Hypertrophy of.—True hypertrophy, that is to say, increase of all the elements, or of the essential elements of the kidney, occurs only in one organ as a rule, and that by way of compensation for atrophy of the other.

Simple increase of bulk of the kidneys often results to a certain extent from congestion, inflammation, the various forms of Bright's disease, new formations, and accumulation of the secretion.

Anatomical Characters.—These present no peculiarity beyond the enlargement, the organ weighing sometimes eight or nine ounces, the renal artery and vein being proportionately enlarged, with a corresponding coarseness of structure.

Symptoms.—Hypertrophy of the kidney is without symptoms, but it might so happen that the enlargement of the organ could be detected on physical examination.

20. Kidney, Infarction in.—*See* Kidney, Embolism of.

21. Kidney, Inflammations of.—Inflammation of the kidneys and their pelves presents many varieties. The kidneys themselves exhibit, first, tubular inflammation, acute or chronic; second, inflammation of the stroma, acute or chronic; third, suppurative inflammation of the substance of the organ, septic or non-septic. The renal pelvis is also liable to acute or chronic inflammation. It will serve no useful purpose to discuss these in a general article, and therefore the reader is referred to the several special articles. *See* Bright's Disease; Kidney, Suppurative Inflammation of; and Kidney, Inflammation of Pelvis of.

22. Kidney, Inflammation of Pelvis of. Synon.: Pyelitis; Fr. *Pyélite*; Ger. *Nierenbeckenentzündung.*

Definition.—An acute or chronic disease of the pelvis of the kidney, caused by extension of inflammation or of irritation from the neighbouring parts, by renal calculus, by cold, or by blood-poisoning; consisting in inflammation of the mucous membrane, frequently associated with changes in the other coats and in neighbouring parts; characterised by the presence of mucus or pus in the secretion, with local pain, and more or less constitutional disturbance; sometimes resulting in recovery, sometimes in long-continued illness, and occasionally in death.

Ætiology.—Pyelitis is caused by:—(1) extension of inflammation from neighbouring parts of the urinary tract sometimes from the kidneys, sometimes from the bladder; (2) stagnation and decomposition of the urine in the renal pelvis; (3) mechanical irritation, as from calculi and gravel; (4) exposure to cold; (5) certain blood-poisons, such as those of pyæmia, diphtheria, and typhus; (6) the action of certain other poisons.

Anatomical Characters.—Three types of pyelitis may be recognised, namely:—(1) the *acute*; (2) the *chronic*; and (3) the *calculous.*

(1) *Acute.*—The mucous membrane is congested, and its surface coated with mucus, sometimes with a bloody, sometimes with a diphtheritic layer. The membrane itself may be more or less extensively destroyed; and the characteristic tailed cells of the pelvis of the kidney may be thrown off in excessive quantity. Besides these cells, the cavity contains mucus or muco-purulent material in quantity.

(2) *Chronic.*—In this condition the mucous membrane is much thickened, often of a slate-grey colour, with ecchymoses, and sometimes with ulcerative abrasions of the surface. The other coats of the pelvis and ureter may also be distinctly thickened, and the lumen of the ureter may be more or less narrowed, The cavity contains purulent material, with *débris* of broken-down mucous membrane; and sometimes, the ureter being obstructed, great accumulation of pus takes place, so as to expand the pelvis and lead to partial atrophy of the kidney (*pyonephrosis*).

(3) *Calculous.*—In this form the mucous membrane may present either of the conditions above described, but one always finds mingled with the other materials calculi of greater or less size.

Symptoms.—The symptoms of *acute* pyelitis may be either well-defined, or masked. There may be uneasiness or acute pain in the loins and along the line of the ureter; sometimes distinct rigors, with other febrile symptoms, occur; and the urine is cloudy, depositing mucus or muco-purulent material, or sometimes blood. The most characteristic feature is the presence in the urine of the angular tailed cells which line the pelvis of the kidney. The condition may gradually subside, or may become chronic; or in rare cases, and where important complications exist, it may prove fatal.

In *chronic* pyelitis there is often an aching feeling, or well-defined pain in the region of the

ureters. There is constitutional disturbance, debility, fever, hectic; the urine is opaque, and deposits pus—generally grey, sometimes tinged with blood. This condition may go on for long periods, sometimes terminating in recovery, but often persisting and proving fatal by exhaustion, by extension to the kidney-substance or to the cellular tissue, or by concomitant complications.

The *calculous* form differs from the others in respect of its cause; and in being attended by more pain, by more tendency to hæmorrhage, and sometimes by the presence of crystals, gravel, or calculi in the deposit.

If the escape of the pus should be prevented in any of the three forms of pyelitis, owing to obstruction of the ureter, and pyonephrosis result, a fulness or fluctuating tumour may be detected in the renal region, and this in some instances subsides at intervals, with a copious discharge of pus in the urine.

Diagnosis.—From cystitis, pyelitis is distinguished by the absence of vesical pain, and of frequent calls to micturition; and by the presence of the lumbar uneasiness, and the more intimate admixture of the foreign materials with the secretion. From renal inflammation it is distinguished by the absence of tube-casts; the seat of the pain; and the presence of the characteristic cells of the renal pelvis. From strumous kidney it is sometimes almost impossible to differentiate simple pyelitis. Indeed the two conditions are not unfrequently associated together, but the presence of other evidences of strumous disease, the enlargement of one or both kidneys, and the presence of copious *débris*, in addition to the pus, often suffice to distinguish the one from the other.

Prognosis.—In the slighter and acute forms of pyelitis, the prognosis is generally favourable. In the chronic variety it must always be guarded, the amount of danger being determined in some measure by the cause, the constitutional conditions, and the complications.

Treatment.—The first essential is that the patient should have rest, and that the urinary secretion should be copious and bland. In order to secure this a diet largely composed of milk and simple diluents, or in some cases exclusively of milk, and the avoidance of stimulating foods and drinks, are to be insisted on. As to medicine, if the urine be excessively acid, alkalies should be administered; if it be alkaline, mineral acids should be given. Various remedies which appear to diminish irritation, such as the uva ursi, pareira brava, buchu, triticum repens, copaiva, and sandal-wood oil, ought to be employed. In the acuter cases the application of poultices to the loins, and the internal administration of henbane or opium, are to be recommended.

In the chronic forms of pyelitis a similar line of treatment should be perseveringly followed; and in cases which owe their origin to the presence of calculi, the remedies appropriate to the diathetic condition should be employed. Astringents may possibly be useful in checking too copious a discharge of pus.

23. Kidney, Malformations of. — The commonest malformation of the kidneys is *lobulation*, which is a relic of the fœtal condition. Next comes the undue development of one organ. Sometimes there are two pelves belonging to each kidney, or two ureters. A not very rare anomaly is the *horse-shoe kidney*, which consists simply in the union of the two kidneys, by a band of renal tissue, at either end, usually the lower. This abnormality is often attended by anomalies in the arrangement of the ureters and vessels. A very rare condition is that in which there is a *central union* between the two organs, owing to the development of supplementary renal structure opposite their pelves. None of these malformations lead to any important symptoms, except by pressure upon the duct or vessels, under superadded abnormal conditions of the organs themselves, or of neighbouring parts.

24. Kidney, Malignant Disease of.—Definition.—A chronic disease of the kidney, caused by the circumstances which induce cancer elsewhere; consisting in the formation of nodules of cancer, or the infiltration of the organ with the new formation; characterised by a renal tumour, cachexia, and frequently by alteration of the urine; and resulting in death.

Ætiology.—*Primary* renal cancer arises from causes not yet ascertained. It occurs at two epochs of life, namely, in early childhood and in adult age. Children under four years appear specially liable. The male sex is more frequently affected than the female; the right kidney more commonly than the left.

Secondary cancer of the kidney is most frequently associated with carcinoma of the liver, the stomach, the mamma, the testicle, or the uterus; sometimes of the supra-renal bodies, or the mesenteric glands.

Anatomical Characters.—All the varieties of cancer have been met with in the kidney, but the medullary is by far the most common. It is sometimes primary, sometimes secondary. The *primary* affects usually one kidney, most commonly the right; the organ is often much enlarged, weighing sometimes as much as sixteen or seventeen pounds, and this even in young children. In ten children Dr. Roberts found the average weight $8\frac{3}{4}$ lbs.; in ten adults he found it $9\frac{3}{4}$ lbs. Such large tumours occupy a great part of the abdomen, and push the colon forward. The cancer is in some cases scattered in separate nodules; in others it is infiltrated through the mass. It commences always in the cortical substance, and is developed from the fibrous stroma. In the scattered cases the remaining portions of the kidney are quite sound. The cancer may involve the sub-mucous tissue of the mucous membrane of the pelvis, the ureters, and the veins. The lymphatic vessels and glands also become secondarily affected. Sometimes it affects the peritoneum, colon, and it has even involved the skin.

When the renal affection is secondary, it constantly affects both organs, and rarely leads to such enlargement as is seen in the primary disease. It occurs in the form of numerous nodules, developed in the stroma or along the vessels. The remaining renal tissue is commonly healthy, but it may be inflamed or otherwise altered.

Symptoms.—The symptoms of primary cancer generally become quite distinct when the disease

advances, but in the earlier stages they are very indistinct. The urine itself is, as a rule, natural in quantity, of acid reaction, normal specific gravity and colour; but from time to time blood appears, its amount varying from a mere trace to a very serious hæmorrhage. Sometimes the blood is in clots, and this bleeding may be the earliest symptom; and it occasionally happens that carcinomatous elements may be discovered in the urinary deposit, but it is very difficult to be sure of their presence.

Examination of the abdomen reveals the presence of a tumour, occupying and extending from the region of the kidney. The tumour is generally nodulated, of tolerably firm consistence, and dull on percussion. The colon lies in front of the mass, which is capable of being tilted forward by pressure on the renal region. When the left kidney is affected, the spleen is displaced upwards. As a rule, there is persistent constipation, and some pain, together with the general symptoms of the carcinomatous cachexia.

Diagnosis.—Carcinoma of the *left* kidney may be confounded with enlargement of the spleen; with perinephric abscess; perhaps sometimes with disease of the mesenteric glands; or with obstruction of the colon, and retention of fæces.

From splenic tumour it is distinguished by its lower position, and the absence of the splenic notch; the normal condition of the blood; and the presence of blood in the urine; also by the nodulated character of the tumour itself, and by the position of the colon.

From perinephric abscess it is distinguished by the absence of fever, and of fluctuation; as well as by the less rapid advance of the disease.

From tumours of the mesenteric glands renal cancer is distinguished by its situation, being more towards the side and the lumbar region. The mass also is less nodular than in mesenteric growths, which are composed of groups of glands.

From carcinoma of the intestine, with accumulation of fæces above it, it is distinguished by the position of the mass, and by its characters on palpation; as well as by absence of the signs proper to the intestinal disease.

Carcinoma of the *right* kidney may be confounded with tumour of the liver, especially in children; but the presence of a space of clear percussion, more or less extended between the liver and the tumour, should remove all doubt. If the diseased kidney touches the liver, reliance must be placed on the symptoms proper to renal or to hepatic disease.

Cancer of the kidney is to be distinguished from tumour of the ovary, by its more fixed condition, and the history of its growth.

Prognosis.—The prognosis is in all cases unfavourable; the duration varies with the form of cancer. Dr. Walshe thinks eight months the average, but that probably is too short.

Treatment.—Treatment is, of course, merely palliative—morphia, belladonna, henbane, applied externally or injected subcutaneously to relieve pain; ergotine and other preparations of ergot, acetate of lead, and gallic acid to check hæmorrhage; and iron as an astringent and blood-tonic. The bowels require careful attention; and sometimes there may be so much ascites as to warrant tapping.

25. **Kidney, Malpositions of.**—The kidney may be congenitally displaced, but the important anomaly coming under this head is the *movable kidney*, which demands special consideration.

Definition.—The movable kidney is a condition especially affecting women; consisting in the undue mobility of one, or rarely of both kidneys; characterised in some cases by no symptoms, in others by uneasiness or pain and general nervous disturbance, and by the presence of a tender reniform tumour, with clear note on percussion in the renal region of the affected side; resulting, as a rule, in frequent recurrence of the symptoms without danger to life.

Ætiology.—Movable kidney is more common in the female sex, and especially in those who have passed through many pregnancies, but it is not exclusively associated with women, for it occurs (although rarely) in males, and also in children. The right kidney is much more frequently affected—65 out of 91 cases (Ebstein). Its occurrence is probably mainly due to laxity of the abdominal parietes, and unusual length, or irregular distribution, of the renal vessels.

Anatomical Characters.—The kidney is not necessarily changed in its structure, but its position may be altered in any direction.

Symptoms.—In many cases no symptoms occur in movable kidney. But in some, whenever the displacement occurs, much uneasiness or even considerable pain is experienced. The writer has known a man unable to work in consequence of the pain induced by the displacement, and losing a day's work regularly once a week or once a fortnight. The sensations are generally rather of the nature of vague uneasiness than of actual pain, except when the organ is touched, and then there is pain of a peculiar and sickening kind. On percussion over the renal region posteriorly a clear note may be elicited on the affected side, and sometimes a flattening may be made out at the part. The urine sometimes becomes altered during the attacks, depositing mucus and in one case in the writer's practice a little blood. Careful palpation reveals a tumour, of characteristic renal form; and now and then pulsation of the renal artery may be felt. The morbid condition may recur at intervals during many years, and is in some cases apparent for a time, and then absent for a very long period. It is liable to be brought on by effort, but often appears without discoverable cause. Occasionally it is found that the displaced kidney owes its position to the existence of carcinoma or other disease of the organ.

Diagnosis.—The malady may be confounded with tumour of a malignant nature, originating either in the abdomen or the pelvis. The diagnostic points are, the fever; the peculiar tenderness; the mobility; the occasional disappearance; the unchanging character of the tumour; and the occurrence of a clear percussion-note and flattening in the renal region of the affected side.

Prognosis.—The prognosis is favourable.

Treatment.—The treatment should be by means of bandages or trusses, to support the abdominal walls, and keep up a pressure upon the kidney, so as to retain it in its normal situation. In the case of the working man above referred

to, complete immunity from the displacement was obtained by the use of a bandage with a pad so arranged as to keep up a pressure upon the organ.

26. **Kidney, Morbid Growths of.**— The only really important morbid growths of the kidney are cancer and tubercle. Syphilitic new formations occasionally occur, but give rise to no characteristic symptoms. Growths of fibrous, fatty, bony, muscular, and glandular tissue have all been met with in a few cases. Hydatid disease may also be mentioned.

27. **Kidney, Parasites of.**—The parasites which have been described as existing in the human kidneys are Hydatids, Strongylus gigas, Pentastoma denticulatum, and Bilharzia hæmatobia.

The Strongylus gigas is a large nematode worm, and is extremely rare in man. The Pentastoma denticulatum is the larval form of P. tænioides, one of the Arachnida. It was found in one case by Wagner. Bilharzia hæmatobia is a trematode worm, about three or four lines in length; and inhabits the branches of the portal system, and the minute veins of the pelvis of the kidney, ureter, and bladder. The parasite also affects these structures themselves. So common is it in Egypt, that out of 363 *post-mortem* examinations, Griesinger found it 117 times.

Symptoms.—Hydatid-disease gives rise to a tumour. The symptoms produced by the presence of Bilharzia in the kidney are hæmaturia, with irritation of the urinary tract. This parasite is the cause of the endemic hæmaturia of certain regions. The other parasites do not originate any definite symptoms.

Treatment.—In the treatment of patients affected with Bilharzia hæmatobia, the internal use of oil of turpentine, and of the extract of the male shield fern, is recommended. It is stated that when the bladder is affected, injections of iodide of potassium, twenty or thirty grains dissolved in tepid water, repeated every second or third day, have been found useful. *See* Kidney, Hydatid Disease of; Strongylus gigas, &c.

28. **Kidney, Suppurative Inflammation of.**—Definition.—An acute or sub-acute disease of the kidneys; caused by injuries, extension of disease from the bladder, and perhaps exposure; consisting in inflammation and suppuration in the kidney; characterised by constitutional disturbance, with local pain or tenderness, and various alterations of secretion; and usually resulting in death.

Ætiology.—The commonest causes of this disease are renal calculus, leading to inflammation of the pelvis of the kidney; or inflammation of this part, propagated upwards from the bladder or urethra. Next in frequency is pyæmia, which induces metastatic abscesses. Comparatively rarely the inflammation is a result of embolism of the renal arteries; of injuries; and perhaps of exposure to cold.

Anatomical Characters.—The affected organs are generally above the natural size. The capsule may strip off readily, but often, as it is being stripped, leads to tearing of the substance, and liberation of pus. The surface is frequently discoloured in patches. The abscesses may be described as passing through several stages. There is first the stage of congestion, with exudation into the stroma of the organ; secondly, the stage of grey consolidation; and thirdly that of suppuration. Occasionally sloughing occurs. Sometimes perinephric abscess results, from perforation of the capsule. Drying up of the pus, with shrivelling of the affected area, is sometimes met with.

Microscopic examination reveals in some cases at an early stage the presence of colonies of bacteria in certain districts within the tubules, causing irritation first in them, then in the stroma, and thus inducing suppuration.

Symptoms.—The most important clinical features of suppurative nephritis are the constitutional disturbance, accompanied by pain in the region of the kidneys, and tenderness on pressure, with scantiness of secretion; the urine being albuminous or bloody, or sometimes purulent, and depositing tube-casts.

Diagnosis.—From pyelitis, suppurative inflammation of the kidneys is distinguished by the presence of tube-casts, and the absence of the characteristic angular cells of the calices of the pelvis. From perinephritis, it is diagnosed by the absence of distinct tumour, and by the history of the case.

Prognosis.—The prognosis is generally grave.

Treatment.—The strength should be supported by suitable food, by tonics, and stimulants when necessary; and in some cases benefit may be derived from poulticing, fomentation, or from the application of leeches. Under suitable conditions it might be desirable to open a renal abscess, and evacuate the pus.

29. **Kidney, Syphilitic Disease of.**—Syphilis may produce in the kidney, as in other organs, congestion, inflammation—either simple or gummatous, with the cicatrices and nodules resulting therefrom, and waxy or amyloid degeneration.

Ætiology.—Nothing is known as to the conditions which determine the action of the syphilitic poison upon the kidney.

Anatomical Characters.—There is scarcely ever an opportunity of studying the appearances of the kidney in cases of congestion—probably over-filling of the vessels, with slight inflammatory conditions of the tubules, is all that would be found. The simple interstitial inflammation is characterised by thickening and swelling of the fibrous stroma, in patches here and there. Gummatous inflammation is rare, but when it does occur, it forms masses of the ordinary gummy character. Either of these conditions may lead to the formation of syphilitic cicatrices, which may appear on the surface of the organ, or be imbedded in the cortical substance. Their formation is attended by the destruction of tubules in the affected parts.

Symptoms.—Albuminuria, slight in amount and of temporary duration, occurring along with other syphilitic congestive affections, has appeared to the writer to indicate renal congestion. Various slight cases of inflammatory Bright's disease, have appeared to be due to the syphilitic poison. The symptoms of the inter-

stitial and gummy inflammations are not ascertained, although probably albuminuria attends them also. The symptoms of waxy degeneration are described under BRIGHT'S DISEASE.

DIAGNOSIS.—The diagnosis of syphilitic disease of the kidney depends upon the co-existence of renal symptoms with evidences of syphilis, while other diseases of the kidney are excluded.

PROGNOSIS.—This is favourable so far as danger is concerned, except in the case of severe waxy degeneration.

TREATMENT.—Iodide of potassium has been found to be useful in this as in other syphilitic affections, at least in the congestive and inflammatory conditions. Should it fail to give relief, the bichloride of mercury may be given in moderate doses, and continued cautiously even when albuminuria is present.

30. Kidney, Tuberculosis of.—DEFINITION. A chronic disease of the kidneys and ureters; caused by tubercular infection, or by strumous inflammation of the structures involved; consisting in the formation of nodules of tubercle, or in strumous inflammation of the substance of the gland, and of the mucous membrane; characterised by some constitutional disturbance, sometimes by renal tumour, and by various alterations of the urine, particularly deposit of caseous purulent *débris*; and resulting usually in death.

ÆTIOLOGY.—The direct causes of tubercular disease of the kidney are unknown. It is more common in children and young people than in those more advanced in life, but it—especially the scrofulous form—may occur later on. Men are decidedly more frequently affected than women. The kidneys are rarely equally involved; the right is commonly worse than the left. One organ may be quite free from disease.

ANATOMICAL CHARACTERS.—Under this term are included both tubercle proper, and strumous inflammation. Tubercle proper occurs in the form of minute miliary nodules scattered throughout the substance of the organ, as a local manifestation of a general true tuberculosis. Strumous inflammation leads to the formation of larger masses, involving either the mucous membrane of the pelvis of the kidney, or the cortical substance. When the former is its seat, it leads to a thickening of the mucous membrane, commencing in patches which gradually extend, and ultimately undergo ulceration. When the cortical substance is affected, the organ becomes enlarged; presents a markedly lobulated surface; and on section conical masses of altered tissue are found to correspond to the prominences of the lobules. Some of them are solid and cheesy; others are softened in the centre; while others are completely softened, so that on section a quantity of puriform *débris* flows out, leaving a cavity with white walls, rendered shaggy by the shreds of fibrous tissue which project from them. Sometimes scarcely any renal structure is left. Occasionally what remains shows the characters of waxy degeneration. The disease commences in the stroma of the organ; the tubules are compressed, but are rarely the seat of inflammatory changes. When the mucous membrane of the pelvis of the kidney and the ureter is affected, the membrane is thickened at certain parts, and afterwards becomes ulcerated; and the lumen is diminished, or completely choked up by granular *débris*. Frequently both the mucous membrane and the substance of the kidney are affected. It occasionally happens, when one kidney is exclusively affected, that shrinking of the gland takes place; and a putty-like material, rich in cholesterine, or perhaps even calcareous nodules are found, occupying the smooth-walled cavities produced by the disease. Tuberculosis of the ureters, prostate, vesiculæ seminales, bladder, and testicle not unfrequently co-exists.

SYMPTOMS.—When tubercle occurs in small nodules it produces no symptoms, and even in the inflammatory form the constitutional symptoms are, in the earlier stages, not very well-marked; but as the disease advances, fever, passing gradually into the hectic type, is developed. The local symptoms may be negative, but there is frequently pain in the affected organ, with tenderness on pressure; and in some cases a tumour may be felt in front, or percussion may reveal an increased area of dulness in one or both renal regions. The secretion may be normal, or even sometimes excessive in quantity, when the disease is not far advanced. It may be acid or alkaline, of fair specific gravity, albuminous, and sometimes bloody. It often contains a puriform material, with *débris* of renal tissue. Sometimes there are masses of cheesy material, which are eminently characteristic, occurring in no other form of disease of the urinary tract. Occasionally the urine becomes suppressed, and symptoms of uræmia precede the fatal termination. Sometimes a tumour may be felt; and on percussion behind, it may be found that the renal dulness is more extensive on one side than the other.

DIAGNOSIS.—The evidences on which we rely in the diagnosis of tubercular disease of the kidney are the presence of pyelitis, combined with those of tubercular disease in other parts, and above all the deposit in the urine of the characteristic fragments of cheesy tissue above described.

PROGNOSIS.—The prognosis is very unfavourable, on account both of the local and of the constitutional conditions.

TREATMENT.—The treatment is merely palliative, to relieve pain or uneasiness; and to seek to improve the general health, by administering remedies which are useful in strumous affections.

31. Kidney, Tumour of.—Any enlargement connected with the kidney, which reveals itself on clinical examination, is regarded as a renal tumour. This may be due to mere hypertrophy of the organ; any form of cystic disease; accumulation of any fluid in the renal pelvis, or in the kidney itself; or a solid new-growth, especially malignant disease. For a description of the signs of these several conditions, the reader is referred to their respective headings in this article.

T. GRAINGER STEWART.

KIESTINE (κύω, I am pregnant; and ἔσθης, a pellicle).—SYNON.: Fr. *Kyestéine*; Ger. *Kyestein*.—This substance was formerly believed to be peculiar to, and always present in, the urine of women in pregnancy, and it was held, therefore, to be significant of that condition.

Recent investigations show that it may be absent all through pregnancy, or present only during certain months, usually from the second to the seventh; that it may be present in the urine of anæmic persons, male as well as female; and therefore that it has not the diagnostic value which was formerly attached to it.

Kiestine is a nitrogenised body allied to caseine; and, according to Dr. Braxton Hicks, the amount deposited from urine containing it can be augmented by the addition of rennet. Chemically and microscopically it is a variable body. Fat, mucus, crystals of the phosphates, infusoria, and granular matter have been found in it. If urine capable of yielding kiestine be set aside in a tall glass, a cloud, apparently of mucus, becomes visible in the middle of it on the second or third day. This soon rises to the top, and an iridescent pellicle is seen forming on the surface. When this has fully formed, it begins to fall through the fluid in the form of flocculi, until the whole is deposited at the bottom in a whitish layer. Another pellicle containing triple phosphates succeeds this, and putrefactive changes proceed.

No reliance can be placed upon the presence of kiestine as a proof of pregnancy.

ALFRED WILTSHIRE.

KINÆSTHESIS (*κινέω*, I move, and *αἴσθησις*, sensation).—The sense of movement.

In view of the conclusion that the term 'muscular sense' ought to be abolished, as being in several respects misleading, when applied, as it often is (*see* MUSCULAR SENSE) by different writers with totally different significations, partly referring to some and partly to all the impressions which we derive from our moving members, or from movements generally, the writer (*The Brain as an Organ of Mind*, p. 543, and *Appendix*) has proposed to employ the above term as the designation of an important but confessedly complex sense-endowment. He regards it as a form of sense, 'whereby we are made acquainted with the position and movements of our limbs, whereby we judge of "weight" and "resistance," and by means of which the brain also derives much unconscious guidance in the performance of movements generally, but especially in those of the automatic type.' In regard to the various components of this endowment he adds:—'Impressions of various kinds combine for the perfection of this "sense of movement," and in part its cerebral seat or area coincides with that of the sense of touch. There are included under it, as its several components, cutaneous impressions, impressions from muscles and other deep textures of the limbs (such as fasciæ, tendons, and articular surfaces), all of which yield conscious impressions of different degrees of definiteness; and in addition there seems to be a highly important set of "unfelt" impressions, which guide the motor activity of the brain by automatically bringing it into relation with the different degrees of contraction of all muscles that may be in a state of action.'

Kinæsthetic centres or mechanisms would, therefore, in accordance with this view, exist in the brain, just as visual or auditory centres also exist. The cerebral seat or locus pertaining to the movement-sense would perhaps be more diffused, though it would otherwise hold much the same relative rank as the several cortical mechanisms for the more special senses.

DISORDERS OF KINÆSTHESIS.—In certain cerebral and spinal diseases the sense of movement is known to be blunted, or actually abolished, in some parts of the body; and that in regard either to the whole, or only to some of its component impressions. Concerning perversions or exaltations of this endowment, however, we as yet know almost nothing.

Total abolition of the endowment in the limbs, on one side of the body, exists in certain rare cases of hemianæsthesia, where there is also complete loss of tactile sensibility. On the other hand, it is partially impaired in both lower extremities, not unfrequently, in cases of locomotor ataxy; whilst in another class of cases, without coexisting anæsthesia, there would seem to be an absence of the ordinary unconscious impressions emanating from muscles in action, and as a consequence motor defects of an ataxic order, so long as the movements attempted are not guided by sight impressions. Incoördinate movements pertaining to this latter category are decidedly rare, and stand in need of further investigation.

H. CHARLTON BASTIAN.

KIN-COUGH (Dutch, *Kienkhoeff*). Also *Chin-cough*. Both of these words are synonyms for whooping cough. *See* WHOOPING COUGH.

KING'S EVIL.—A popular name for scrofula, originating in an idea formerly held that the disease could be cured by the king's touch. *See* SCROFULA.

KISSINGEN, in Bavaria.—Common salt waters. *See* MINERAL WATERS.

KLEPTOMANIA.—Insanity characterised by an irresistible impulse to steal. *See* INSANITY, Legal; and CRIMINAL IRRESPONSIBILITY.

KREUZNACH, in Germany.—Common salt waters containing Iodine. *See* MINERAL WATERS.

KYPHOSIS (*κυφός*, bent).—A synonym for angular deformity of the spine. *See* SPINE, Diseases of.

L

LABIO-GLOSSO-LARYNGEAL PARALYSIS (*labium*, a lip; γλῶσσα, the tongue; and λάρυγξ, the throat).—There are two forms of this disease, which have to be considered separately, namely, (*A*) the **chronic** form; and (*B*) the **acute** form. It will be convenient to discuss the chronic form first.

(*A*) **Chronic Labio-Glosso-Laryngeal Paralysis.**—Synon.: Fr. *Paralysie glosso-labio-laryngée* (Trousseau); Ger. *Progressive Bulbar-paralysie* (Wachsmuth).

Definition.—A progressive symmetrical paralysis of the lips and adjacent facial muscles, of the tongue, pharynx, and sometimes also of the larynx; with or without conspicuous wasting; and often associated with muscular atrophy elsewhere.

History.—First described by Dumesnil, in 1857, and by Duchenne in 1860, the disease was made generally known by Trousseau's lecture, published in 1863. By the latter writer it was termed 'labio-glosso-laryngeal paralysis.' The awkwardness of the German version of the term led Wachsmuth, in 1864, to designate it 'progressive bulbar paralysis,' and German literature has given wide currency to the term, which is, however, open to the objection that the term 'bulbar paralysis' has been applied to all paralyses of the nerves arising from the medulla oblongata.

Ætiology.—Of the causes of the affection little is known. It is a disease of later life, being almost unknown under forty. Males are affected more frequently than females. The disease, as such, does not appear to be inherited, but in many cases there is a family history of other affections of the central nervous system. Of immediate causes, exposure to cold, mental anxiety, and imperfect nourishment have been supposed to exert an influence in some cases.

Anatomical Characters.—The tissue of the affected muscles is pale; fatty tissue may be in excess; and the muscular fibres often, but not always, present granular degeneration. They are frequently narrowed; whilst the tissue between them may be increased in quantity, and may contain pigmentary products of degeneration. The motor nerve-fibres to the muscles are grey, translucent, and under the microscope, degenerated. Their nuclei of origin in the medulla oblongata are also diseased. The motor cells are shrunken and atrophied; their processes are lost; and the intermediate tissue is degenerated. The hypo-glossal nucleus is examined most readily, and the change in it is striking, as well as in the nucleus of the spinal accessory (larynx). The anatomical change which underlies the affection of the lips has not yet been detected. There is some uncertainty of the precise origin of this part of the facial nerve. Guided by Duchenne's clinical observation and conclusion that these fibres, from their affection with those of the hypoglossal, must arise near the nucleus of the latter, Lockhart Clarke believed he had traced them to a group of cells close to the hypoglossal nucleus. Later researches, especially those of Pierret and Meynert, have rendered this conclusion doubtful. It is certain, however, that a large number of the fibres of the facial descend to the level of the hypoglossal nucleus. They diverge from the middle line, close to which the hypoglossal nucleus is situated, and some at least pass towards the lower part of the column of cells, which, above, gives origin to the motor fibres of the fifth nerve. But the physiological association of the movement of the tongue and lips is most close. We cannot narrow the tongue without contracting the orbicularis. Hence it is certain that the lower facial nucleus and the hypoglossal nucleus, whether contiguous or not, are closely connected; and that this connected part of the facial suffers, in this disease, in the same manner as the hypoglossal. The same fact is almost certain of the motor nucleus of the glosso-pharyngeal. When there is muscular atrophy in the limbs, a corresponding degeneration may be found in the anterior cornua of the spinal cord, often conjoined with sclerosis in the lateral columns, and in the anterior pyramids in the medulla. There is every reason to believe that, in the chronic form, the atrophic changes in the nerve-elements are the primary alteration.

Symptoms.—The symptoms have the distribution indicated by the name given to the disease by Trousseau, the affected parts being the lips, tongue, throat, and larynx. They are, so to speak, arranged about the tongue as a centre. It is in this organ that the earliest symptoms commonly present themselves, as a trifling indistinctness of speech, due to an imperfect articulation of those sounds in which the tongue is most concerned—dental and palatine sounds. The tongue can be still protruded, although perhaps not quite so far as normal. The lips then become weak, and sounds in which the lips are concerned are imperfectly articulated. The vowels *o* and *oo*, in the pronunciation of which the orbicularis contracts, cannot be well sounded. The lips are not brought together so perfectly, or separated so promptly, as in health, and the labial explosives, *b* and *p*, become *f*. Whistling is impossible. The lower part of the face loses its expression, the lips are habitually separated, and the saliva cannot be perfectly retained. The difficulty in articulation is soon increased by the weakness of the palate, which ceases to shut off the nasal cavity, so that a nasal resonance accompanies sounds from which it should be absent. The paralysis of the tongue increases until the organ can no longer be protruded. Deglutition becomes impaired, partly (according to Duchenne, wholly) from the weakness of the tongue, but probably in part also from that of the constrictors of the pharynx. The soft palate ultimately hangs motionless, and, during the act of swallowing, does not close the posterior nares, so that liquids regurgitate into the nose. Food is apt to lodge in the upper part of the pharynx, and

crumbs or liquid to get into the larynx. The laryngeal muscles subsequently become weak, and the glottis cannot be closed. Coughing is, therefore, imperfect; air is driven through the larynx, but there is no sudden opening of a previously closed glottis, and hence no explosive cough. In proportion as the glottis is paralysed, phonation is interfered with, but is rarely altogether lost. As the disease progresses the speech becomes almost unintelligible, being reduced to unarticulated vocal sounds. It is to be noted, however, that the habitual articulation is rarely the best possible. Words can be distinctly articulated by a deliberate effort which are scarcely at all articulated in ordinary speech. The saliva can neither be swallowed nor retained within the mouth, and is constantly dribbling over the lower lip, below which the patient has to hold a handkerchief continually. It has been thought that the quantity of saliva is increased, but the evidence of this is insufficient. The condition of the tongue varies much in different cases. In some it is, throughout, large, broad, flabby, and soft to the touch. In others it is conspicuously wasted, and covered with wrinkles and furrows from the shrinking. In some cases the lips retain their normal size; in others they are distinctly thinner than natural. This striking contrast between different cases led Duchenne to distinguish two varieties, the *atrophic* and the *paralytic*. Most later writers have, however, rejected this distinction, on the ground that, *post mortem*, muscular wasting has always been found, whether the tongue was large or shrunken. In the former condition fatty tissue prevents the wasting from being conspicuous during life. There is certainly, however, a marked contrast between the appearance of the tongue in the two cases. In the affected muscles the electrical irritability is usually little changed; they still contract to the faradaic current, even when the atrophy is conspicuous. Erb found, however, in one case, indication of the reaction of degeneration, in undue readiness of contraction to the anodal (positive) closure. Other muscles of the head are rarely affected. Those in the upper part of the face always escape. But in many cases muscular atrophy in the limbs, in greater or less degree, is associated, with or without 'contracture.' So, too, in cases of ordinary muscular atrophy, commencing in the limbs, the lips, tongue, and throat are often affected towards the end of the case, in the same manner as in the disease now under consideration. Death, in labio-glossal paralysis, is usually the result of asthenia, due, in part, to the difficulty in deglutition. Sometimes the patient dies in a paroxysm of coughing, occasioned by an ineffectual attempt to swallow liquids or saliva.

Diagnosis.—Before labio-glossal paralysis was well known, the difficulty in swallowing was ascribed to a chronic inflammation of the fauces, but this mistake is now scarcely possible. The symptoms have to be distinguished from those due to other diseases of the medulla, and to disease elsewhere. Many acute lesions, in the region affected in this disease, may cause similar symptoms, but these are distinguished by their sudden onset. Compression of the medulla may also give rise to symptoms of similar distribution, but these are commonly unilateral, and often accompanied by a preponderant affection of the muscular part of the spinal accessory, and by great weakness, without wasting, in the limbs. Occasionally movements of the tongue are impaired by disease of the cerebral hemispheres. The movements of the tongue are especially represented in the lower part of each ascending frontal convolution. When this is diseased on one side, the loss is soon compensated for by the centre in the opposite hemisphere, but a symmetrical bilateral lesion in this situation may cause complete paralysis of the tongue, as in a case recorded by Dr. Barlow. Such paralysis also is acute in onset.

Prognosis.—The prognosis is most grave. The disease consists in a slow degeneration of the nerve-elements, and although, in some cases, a temporary arrest may be obtained, it is doubtful whether, in any instance of this form, considerable improvement has occurred.

Treatment.—The degenerative tendency of chronic labio-glosso-laryngeal paralysis is usually beyond the reach of remedies. Therapeutical efforts must be directed to the endeavour to retard it by nervine tonics, quinine, strychnine, arsenic, nitrate of silver, and the like. The writer is unable to agree with Erb's condemnation of strychnia as harmful in these cases, although he has seen little benefit from its use. Electricity may be tried, although too often it is unsuccessful. Faradisation should be applied to the affected muscles, if they still react to it. Erb strongly recommends the application of the voltaic current through the throat, the positive electrode being placed on the back of the neck, the negative stroked down the side of the pharynx externally, and such a strength being employed as shall produce reflex movements of deglutition. Change of air is desirable in the early stage, and rest is imperative. Food must be carefully regulated; easily digestible varieties being reduced to a semi-solid condition. In the later stages, should swallowing be impossible, nourishment must be administered by an œsophageal tube, or, what is better, by a catheter introduced through the nose. Belladonna or atropine may, to some extent, check the troublesome flow of saliva.

(*B*) Acute Labio-Glosso-Laryngeal Paralysis. — Synon.: Acute bulbar paralysis; *Myelitis bulbi*.

Definition.—Paralysis of similar distribution to that of the chronic form, with or without conspicuous wasting, of sudden onset, and due to an acute process.

Ætiology.—The causes of this affection are for the most part those which lead to acute lesions elsewhere in the brain, especially degeneration of vessels, syphilitic disease, and injuries. It is a disease chiefly of late life.

Anatomical Characters.—Little is known of the exact condition in cases of acute onset which have recovered with persistent labio-glossal paralysis. In cases which have died rapidly, foci of softening in the medulla have been found; and there is reason to believe that such softening, from vascular occlusion, is the most common cause of the condition. Probably a small hæmorrhage may also give rise to it. The symmetry of the symptoms in the acute form, and their

limitation to the parts which are affected in the chronic disease, show the close relation of the central structures, so that they are all affected by the one lesion. The wasting in some of the cases of this variety is very much slower than that which follows an acute lesion of motor grey matter elsewhere. It is possible that the ascending fibres from the nuclei concerned may pass up close to the middle line, in a situation in which all may be damaged by a single lesion.

Symptoms.—The onset is sudden, often with headache and giddiness, rarely with loss of consciousness. The patient suddenly finds a difficulty in swallowing and in articulation, with inability to protrude the tongue. Respiratory disturbances—cough, dyspnœa, and hiccough—may be present. There may be convulsions and weakness in the limbs, sometimes with tingling, but very rarely with loss of sensibility. Many cases which present these symptoms die rapidly in the course of a few hours or days. In those which recover, a paralysis of the tongue, lips, throat, and larynx may remain, identical in all respects with that which characterises the chronic form, and there may or may not be conspicuous wasting. The course is, however, not progressive. The patient may remain in the same condition for a considerable time, and even exhibit marked improvement.

Diagnosis.—The diagnosis of the acute form of labio-glosso-laryngeal paralysis calls for little remark. It must be remembered that the symptoms may deviate from the type more than in the chronic variety, as the lesion sometimes produces irregular effects. It is chiefly liable to be confounded with the impairment of movements of the palate and tongue sometimes left after double hemiplegia, from which the history suffices to distinguish it, the two attacks of hemiplegia usually occurring at different times. The rare symmetrical affection of the surface-centres for the tongue, mentioned above, is also not simultaneous on the two sides, and it is associated with at least transient hemiplegic weakness.

Prognosis.—If the patient recover from the immediate effects of the lesion, the prognosis of the paralysis of the lips, tongue, and other parts is better than in the chronic form, inasmuch as recovery of slightly damaged structures may lead to a considerable degree of restoration of power. The prognosis is also better if there is any reason to ascribe the mischief to syphilitic disease Nevertheless, in some acute cases the paralysis remains absolute, although even in these there is not the tendency to increase which is seen in the chronic variety.

Treatment.—Any causal indication must be carefully sought for in acute labio-glosso-laryngeal paralysis, and treated, especially evidence of syphilis. In other conditions the treatment is that for the lesion which is supposed to exist. Electrical treatment of the muscles is of great importance, in order to prevent, as far as possible, secondary degenerations, which are apt to occur before the partially damaged structures have recovered. The remarks regarding feeding in the chronic form are equally applicable to the acute variety.

W. R. Gowers.

LACHRYMAL APPARATUS, Diseases of (*Δάκρυμα*, a tear).

The lachrymal apparatus consists of the gland, with its excretory ducts; and of the puncta, the canaliculi, the lachrymal sac, and the nasal duct, through which superfluous tears are conveyed into the nose. The diseases of this apparatus are almost limited, with the exception of growths affecting the gland itself (*see* Orbit, Diseases of), to the excessive secretion of tears, and to impediments to their escape into the nose. To excessive secretion, or to impeded outflow, the common term *epiphora* has been applied; but the great majority of cases of epiphora are due to the latter of the two causes.

Epiphora.—*Excessive secretion of tears* is described by authors as an affection for which it is not always possible to discover an adequate cause, and it may perhaps be sometimes due to the prolonged operation of emotional influences. In most instances, however, it is associated with some kind or degree of conjunctival irritation, and is to be regarded only as a reflex phenomenon hence arising. It is well known that any temporary or accidental irritation, such as may arise from the intrusion of a foreign body into the conjunctival sac, is apt to be followed by a copious secretion of tears, which assist in dislodging the offender; and irritations of a more chronic kind, produced by congestion or irregularity of the lining membrane of the lids, may have a similar effect.

Impediments to the escape of the tears, causing them to collect in the conjunctival sac, or even to flow over the cheek, may depend upon displacement of the puncta, so that these apertures are no longer applied to the conjunctival surface, from which they normally remove superabundant moisture by capillary attraction. Such displacements affect chiefly the punctum of the lower lid; and may be consequent either upon conjunctival swelling, by which the lid is pushed away from the eye, or upon paralysis or weakness of the orbicularis muscle, which allows the lid to fall by the action of gravity. In some cases epiphora will depend upon obliteration or occlusion of the puncta. The former condition is incurable; the latter may be produced by plugs of inspissated mucus, which may be removed by the careful employment of a probe.

But the most ordinary cause of obstruction is stricture of the nasal duct; in which condition the tears are arrested a little below the sac, and the sac consequently becomes over-distended. In this condition, the sac can be seen and felt as a small lump, situated just beneath the *tendo oculi*. When pressure is made upon this lump, a fluid, consisting of tears mixed with more or less mucus or muco-pus, will regurgitate into the eye, and the lump itself will disappear. The danger in such cases is that the continued distension of the sac will in time excite inflammation of its lining membrane, leading to the formation of pus, and this to an opening upon the cheek, producing what is called a *lachrymal fistula*. Such an opening never heals until the duct is again pervious, and it is liable to undergo periodic attacks of unsightly inflammation.

Treatment.—In all cases of lachrymal hypersecretion, the first thing to be done is to search

under the lids for any concealed foreign body which may be lurking there. If none be detected, examination must be made for conditions likely to be irritating; and they are to be treated, if they exist, by mild astringent or other suitable local applications. There is probably no medicine which can be said to exert any positive effect in diminishing the amount of the lachrymal secretion.

If the displacement of the lid can be cured by treatment addressed to its causes, the tears will usually return to their accustomed channel. If the displacement be incurable, as happens in some cases of paralysis of the *portio dura*, or of chronic ectropion, the patient may often be relieved by slitting open the canaliculus as far as the caruncle, so as to carry back the aperture to the secretion which it is designed to remove.

The treatment of stricture of the nasal duct can often be only palliative. The patient should acquire the habit of emptying the distended sac by finger-pressure many times a day, and of wiping away the fluid; while, to diminish the irritation of the mucous membrane, a drop of any mild astringent lotion may be applied to the inner corner of the conjunctiva two or three times a day, immediately after such pressure has been made. Perhaps the lotion most generally suitable for this purpose is a solution of acetate of lead in distilled water, of a strength not exceeding three grains to the ounce.

When a radical cure is desired, the canaliculus must be slit up, and the patency of the duct restored by the passage of probes through the stricture. If fistula has already formed, or even if the sac is the seat of an abscess, no other plan is available; but for the necessary details the reader is referred to works on ophthalmic surgery.

R. Brudenell Carter.

LACTATION, Disorders of.—The disorders of lactation are numerous. Sometimes the quantity of the lacteal secretion is excessively small and quite inadequate for the support of the child. At other times it is so abundant that the milk will flow from one nipple as the infant is sucking the other; and when the child is removed from the breast, the secretion continues from both sides. The term *agalactia* is applied to the former, and *galactorrhœa* to the latter condition.

1. **Agalactia** signifies either a total suppression of the mammary secretion, or a very scanty supply. It results generally from anæmia.

The *treatment* should be directed towards improving the health of the patient as much as possible, by a generous diet, and tonics, particularly those containing iron. Certain drugs have been employed as galactagogues, and, it has been said, with benefit. The leaves of the castor-oil plant, boiled, have been used as a local application—the liquid for fomentation, and the leaves as a poultice; and a strong decoction of the same plant has been given as a drink. It is doubtful, however, whether such remedies are efficacious. *See* Galactagogues.

2. **Galactorrhœa** occurs in two forms. In one the composition of the milk is normal, but the quantity excessive; in the other form the increase in the bulk of the secretion is due to a preponderance of the watery part of the fluid.

Remedies employed to reduce the amount of the mammary secretion are termed *galactophyga*, and the chief of these are belladonna and iodide of potassium. Belladonna is employed as an outward application, as well as administered internally. The extract rubbed up with glycerine may be spread on lint, and thus applied to the breasts, or the emplastrum belladonnæ may be used. The child should not be put to the breast too frequently. If the excessive secretion continue for any length of time, great emaciation may result; and to this condition the term *mammary diabetes* has been applied. Under such circumstances lactation should be entirely stopped as soon as possible. Strapping the breasts tightly immediately after they have been emptied is of use. Every care must be taken to avoid the formation of a mammary abscess; and if the breasts get hard and knotty a breast-pump should be employed to free the tubes.

3. **Depressed nipples** are generally produced by the pressure of stays. If this condition be observed during pregnancy, periodic attempts should be made to draw the nipples out by means of a glass nipple-shield, to which an india-rubber tube and teat is attached.

4. **Fissures and excoriations of the nipples** often lead to abscess, and it is said that it may sometimes lead to malignant disease. To avoid the occurrence of these, astringents should be applied to the nipples during pregnancy, in order to harden them. Eau-de-cologne and water, brandy and water, or a weak solution of tannin may be employed for this purpose.

Sometimes an abrasion on the surface forms an ulcer or a crack at some part of the nipple, most frequently at its base, which gives rise to great pain during suckling. The remedies for these cracks are astringent applications, such as tannin, flexible collodion, or a weak solution of nitrate of silver. Care should be taken to sponge these away before the infant is again put to the breast; and a nipple-shield with an india-rubber teat will be found of great service.

For abscess and other morbid conditions of the mammary gland supervening during lactation *see* Breast, Diseases of; Milk Fever; and Nipple, Diseases of. Clement Godson.

LACTEAL VESSELS and GLANDS, Diseases of. *See* Mesenteric Glands, Diseases of.

LAGOPHTHALMOS (Λαγώς, a hare; ὀφθαλμός, the eye).—This term is derived from an old supposition that the hare sleeps with its eyes open; and is applied to a condition in which there is inability to close one or both eyes. Lagophthalmos may be due to paralysis of the orbicularis, in which case it will be attended by falling of the lower lid, and will generally be associated with paralysis of other muscles supplied by the *portio dura* (*see* Facial Paralysis); to the contraction of cicatrices; to spasm of the upper eyelid (*see* Third Nerve, Diseases of); or possibly to congenital malformation of the lids. In paralytic lagophthalmos, the treatment is that of facial paralysis. Where there is contraction

or deformity, each case must be considered on its own merits, with regard to the possibility of obtaining relief from a surgical operation.

R. Brudenell Carter.

LARDACEOUS DISEASE (*lardum*, bacon).—A synonym for albuminoid disease, which is so called from the resemblance of the cut surface of an affected organ to raw bacon. *See* Albuminoid Disease.

LARVALIS (*larva*, a mask). — A term usually associated with porrigo. The thick incrustation which is sometimes seen covering the face of children affected with eczema, and constituting a hideous mask to the features, is an example of *porrigo larvalis*, or rather *eczema larvale*, as likewise is ordinary milk-crust.

LARVATED (*larva*, a mask).—A term applied to certain diseases, when their ordinary characters are masked or concealed; as, for example, typhoid fever. *See* Typhoid Fever.

LARYNGEAL PHTHISIS.—A morbid condition of the larynx, supposed to be of a tubercular nature, and either associated or not with pulmonary phthisis. *See* Larynx, Diseases of; and Phthisis.

LARYNGISMUS STRIDULUS (*larynx*, the windpipe; *stridor*, a noise).—A form of obstructed breathing, attended with a peculiar stridor or crowing sound during inspiration, and dependent on spasm of the muscles of the glottis. *See* Larynx, Diseases of; 9. Spasm.

LARYNGITIS.—Inflammation of the larynx. *See* Larynx, Diseases of; 3. Inflammation.

LARYNGOSCOPE, The. (λάρυγξ, the larynx, and σκοπέω, I look.)—Definition.—An instrument for illuminating the interior of the larynx and trachea, and reflecting those parts so as to present their image to the eye of the observer.

Description.—The apparatus for laryngoscopy consist of a small round plane mirror, set on a metal stem and fixed in a wooden handle, for introduction into the throat; and, for concentrating and reflecting the light into the throat, a concave reflector to be worn in front of the fore head, or perforated for wearing in front of the eye of the observer. With this throat-mirror and reflector, any lamp, or even a candle, is available; but brilliant illumination contributes so much to the distinctness of the image that some apparatus to condense the light is also desirable. Either a special apparatus with a bull's-eye lens, or a globe of water, such as a plain round decanter, forms a powerful condenser, and with it the concave reflector may be dispensed with, the light being concentrated directly by the globe of water on the throat of the patient.

Application.—In practising laryngoscopy, the first object is to throw a brilliant light into the pharynx. Sunlight falling directly, or reflected from an ordinary looking-glass, through the mouth into the throat of the patient; bright daylight; or the concentrated light of a lamp or candle, are each of them available for this purpose.

The patient being placed beside and a little in front of the lamp, when the reflector is used; or opposite the window, or lamp and concentrator, if direct light is employed, the operator seats himself opposite him, and adjusts the reflector which he is wearing, or the concentrator in front of the lamp, so that when the patient sits upright, with his head inclined slightly back, his mouth widely open, and the tongue put out, the light shall be concentrated on the back of the pharynx and velum palati.

The first object being thus attained, the next is to throw the light into the larynx. While the patient breathes deeply and quietly, his protruded tongue, protected by a napkin or handkerchief to prevent its slipping, is held steadily but gently forward, either by his own hand, or by the disengaged hand of the operator; and the throat-mirror, *previously warmed* to prevent the condensation of moisture on its surface, held like a pen, is passed into the patient's throat and held with its back steadily pressing against and raising the soft palate and uvula at such an angle that it throws the light into the larynx. This angle will vary according to the position of the patient and the part of the larynx which we wish especially to examine; and the inclination of the mirror must be altered, it must be raised or lowered, brought forward or advanced further in the pharynx, as may be necessary; the operator observing what part is reflected in the mirror, and in moving it being guided by his knowledge of the relation of the various parts of the larynx to each other. Unless the tonsils are enlarged, no part of the fauces or pharynx, except the soft palate and uvula, should be touched; and the operator must be specially careful that the lower edge of the mirror does not come in contact with the back of the pharynx. He must remember also that, while steady pressure can be borne, titillation of any part of the fauces will induce retching. If a patient's nervousness induces retching, or if a spasmodic action of the muscles of the tongue makes it rise, his nervousness must be calmed, he must be induced to take a deep inspiration through the mouth, to accomplish which he will raise the soft palate and depress the tongue, the traction on which must also be slackened. Enlarged tonsils may present an insuperable obstacle to successful examination; in slighter cases either a very large round mirror which presses the tonsils on one side, or a small ovate mirror, should then be used. More frequently a pendulous epiglottis hanging back over the upper part of the larynx impedes the view; in such a case the patient must utter, or try to utter, in a high falsetto tone, a prolonged 'eh,' or he must force a laugh or a cough, and the mirror must be held lower in the pharynx, in a more vertical position.

For the topical treatment of laryngeal diseases, in addition to the laryngoscope the practitioner requires a laryngeal probe or sound, brushes on whalebone or stout wire handles, curved at a suitable angle, for applying solutions; a caustic-holder, similarly curved, for applying solid substances; an injector to apply a shower of fluid or spray; and a scarifying instrument. For the operative treatment of polypus, &c., a set of special forceps, a laryngeal écraseur, special knives, and other instruments are necessary;

while, for use by the patient, a spray-producer or atomiser, and a simple inhaler will be required.

THOMAS JAMES WALKER.

LARYNX, Diseases of. — The functions and peculiar anatomical position of the larynx give to its diseases a special importance; and in addition to such objective and subjective symptoms as are common to affections of other organs, we find here modifications of respiration, vocalisation, and deglutition.

The principal diseases and disorders which affect the larynx may be conveniently enumerated and described in the following order:— 1. Aphonia; 2. Disorders of circulation; 3. Inflammation; 4. Lepra; 5. Lupus; 6. Malignant disease; 7. Paralysis; 8. Polypus; 9. Spasm; and 10. Syphilitic disease. *See* also CROUP; DIPHTHERIA; and TRACHEA, Diseases of.

1. **Aphonia.** — SYNON.: Fr. *Aphonie*; Ger. *Stimmlosigkeit.*

DEFINITION.—Speaking in a whisper, the sound being produced without closure of the vocal cords.

Various modifications of the note, tone, and quality of the laryngeal voice result from changes in the larynx; and if no air passes through the larynx or mouth, as when a patient breathing through a tracheotomy tube attempts to speak, all sound is abolished, the movements of the lips alone being used in the endeavour to form words. Aphonia is the term applied to the voice produced in the mouth when the laryngeal note is withdrawn from it; and this symptom occurs not only as a result of disease, but as a common functional disorder constituting functional hysterical aphonia. In these cases there is no morbid change in the larynx, no affection of its nerves or muscles. The word *paralysis* should never be applied to this or other similar affections without the prefix *simulated*; the power to exercise the voice exists, but the patient holds it in abeyance. The affection is much more frequent in women than in men. It commonly originates in an attack of catarrh, when, owing to the relaxation and congestion of the laryngeal mucous membrane, vocalisation is inconvenient and requires an effort, and the patient whispers to rest his voice, precisely as an exhausted phthisical patient does, even when there is no laryngeal complication. The habit thus originated is maintained for months or years, as long as the unhealthy mental, emotional, and physical condition which we term hysteria lasts; and this may be the only phenomenon of that condition. Like other nervous and hysterical symptoms, nervous aphonia may lead us to suppose the existence of more serious disease; but the patient suffering from nervous aphonia frequently closes the vocal cords in laughing and coughing, while in speaking she never emits even a husky uncertain laryngeal sound. The laryngoscope is of the greatest value for the diagnosis. The interior of the larynx is seen to be free from disease; the vocal cords move during respiration; but when the patient is asked to say *Ah* or *Eh*, they remain apart, or are brought together for an instant (showing that there is no loss of power) and again separated and allowed to remain open, while an apparent effort is made to utter the sound. *See* VOICE, Disorders of.

TREATMENT.—Well-regulated and interesting employment, or amusement and remedies adapted to the general condition of the patient, must be employed; and the patient must be convinced that she has the power to speak, a power which she does not exercise, usually under the belief that she has it not. The mere expression of a confident opinion, or the promise of a successful result to some system of using the voice may suffice; but usually some measure directed to the part is necessary to induce the patient to exercise her will upon the laryngeal muscles, and to speak, and of those which may be used none is so effective as, or more innocent than, electricity, especially when applied to the interior of the larynx. Frequently one application of electricity, particularly when accompanied by the circumstance of a laryngoscopic examination in a dark chamber, makes a sufficiently profound impression on the mind of the patient to restore the voice; the slight pain of the operation occasionally inducing her to exclaim *Oh!* while her attention is diverted from her supposed inability to speak. In using this remedy in these cases, no practitioner can deceive himself into the belief that he is restoring power to a paralysed part; and it is to be regretted that, in describing the treatment of these cases, this belief should be implied, and should have led to a distrust of those who merit the confidence of the public and the profession, from their special skill in the diagnosis and treatment of laryngeal diseases.

2. **Larynx, Disorders of Circulation of.**— *Anæmia* of the larynx does not exist as a separate disease. Like the pallor of the gums, it is described as one of the symptoms of incipient phthisis.

Congestion of the larynx requires a passing notice. Hyperæmia of some portion of the mucous lining of the larynx results from overexertion of the voice, exposure to cold, the action of irritants, or any cause obstructing the circulation through the larynx; and it may be consecutive to laryngitis. It causes more or less persistent hoarseness, and a sense of discomfort in the throat; and it excites what is commonly called a 'tickling cough.' The absence of any more serious source of these symptoms is proved by the laryngoscope.

TREATMENT.—Treatment of congestion of the larynx is unnecessary, beyond resting the voice, if the congestion is merely temporary. If more persistent, at the same time that the voice is rested, and attention paid to any general cause of the congestion which may exist, such as disordered digestion, astringents should be applied locally. The larynx may be brushed out daily with a solution of two scruples of sulphate of zinc, or of chloride of aluminum, in the ounce of water; or a solution of nitrate of silver, ten grains to the ounce, may be used; while the patient should inhale three or four times a day the spray of a solution of alum or tannic acid, of a strength of eight grains to the ounce.

3. **Larynx, Inflammation of.**—The several varieties of laryngitis will be treated of under

the following headings: — (*a*) Acute; (*b*) Chronic; (*c*) Tubercular; (*d*) Spasmodic; (*e*) Œdematous.

(*a*) **Acute Laryngitis.**—Synon.: *Laryngitis catarrhalis, Angina interna, Cynanche laryngea*; Fr. *Laryngite aigue catarrhale*; Ger. *Kehlkopfentzündung*.

Definition.—Inflammation of the mucous membrane, or of the mucous lining and subjacent cellular tissue of the larynx; acute in its onset; rapid in its course; disturbing the functions of respiration, vocalisation and deglutition; and accompanied by inflammatory fever.

Ætiology.—Like all laryngeal diseases, laryngitis is more common among males than females, and among children than adults. Gout, syphilis, and anything which depresses the constitution, may be regarded as predisposing causes. The most frequent exciting cause is exposure to cold; laryngitis is, indeed, one of the regular sequences of catarrh. It occurs as a complication of exanthematous fevers—in measles, usually of the simple catarrhal or stridulous variety; in scarlatina, of an erysipelatous or œdematous character; in small-pox, variolous pustules being found in the larynx; and in enteric fever and typhus, the consecutive laryngitis being of a destructive type, and leading to rapid ulceration. A very bad form of erysipelatous inflammation of the larynx occurs as a rare complication of erysipelas; and the œdematous variety may result from an extension of diffuse inflammation of the cellular tissue of the neck. Traumatic laryngitis follows scalds, the application of irritants to, and wounds of the larynx.

Anatomical Characters.—In acute laryngitis the blood-vessels are dilated; the mucous membrane is swollen, and its consistency altered; its cells are infiltrated by the fluid exuded from the blood; and its surface possibly eroded, even in the mildest cases. In the more severe (*parenchymateuse*) form of laryngitis, the cellular tissue is similarly involved; the exudation is extensive; and the functions of the muscles being seriously interfered with, the movements of the arytænoid cartilages and vocal cords are greatly impeded.

Symptoms.—When laryngitis supervenes on catarrh, the patient feels and shows that there is more serious illness. He is restless and anxious; experiences a feeling of constriction about the rima; complains of sore-throat in swallowing; and points to the larynx as the seat of pain. The breathing is altered, having more or less the characteristics of laryngeal obstruction, namely, the long-drawn hissing inspiration, prolonged expiration of the same character, but with less of the sibilant sound, and diminution or complete abolition of any pause between each respiratory effort. The voice also is altered, becoming husky and uncertain, deeper in tone, and croaking in quality. The patient likewise suffers from cough, of the same character as the voice; from the imperfect closure of the vocal cords it wants sharpness, is husky, and sometimes is accompanied by a hollow, clanging sound, constituting what is commonly called the croupy cough. The expectoration varies according as the inflammation involves the larynx alone, or extends to the trachea and bronchi. In the former case it is usually clear, thin, tenacious mucus, which is *hawked*, rather than coughed up, mixed with the saliva, which is freely secreted but not swallowed. Sometimes the expectoration contains harder pellets, secreted in the ventricles of the larynx; whilst, if the trachea and bronchi are involved, the usual thick expectoration of bronchitis is also coughed up. Deglutition is painful and difficult; while, on inspection, the throat shows only a little redness, quite inadequate to account for the dysphagia. Accompanying these symptoms there is a rapid pulse, and slight rise of temperature, though the tongue may be moist, and other indications of inflammatory fever slight.

With the laryngoscope the whole interior of the larynx is seen to be of a bright red colour, the vocal cords alone usually retaining their white appearance, but with bright vascular patches; in severer cases the swelling, caused by the infiltration of the mucous membrane and subjacent cellular tissue, is also perceptible.

If the case progress untowardly, the restlessness and anxiety increase; suffocative paroxysms occur, and recur with increasing frequency; the patient's whole attention appears concentrated on the effort of breathing; he dreads to speak or swallow, and if obliged to say anything, he takes first a laboured inspiration, and then with a straining effort, painful to witness, brings out what little voice is left. Gradually, as the aëration of the blood becomes more imperfect, drowsiness comes on; the eyes, staring in the previous stage, are half closed by the drooping lids; the face, bathed in perspiration, becomes livid; and death occurs, probably in a paroxysm of suffocative dyspnœa.

Complications and Sequelæ.—The complication of laryngitis with other inflammatory diseases of the respiratory system will be referred to immediately, but there are two symptoms, namely, œdema and spasm, which complicate laryngitis, and by their prominence give a distinctive character to the disease. *See* Œdematous Laryngitis.

Diagnosis.—Acute laryngitis, whether simple, stridulous, or œdematous, is apt to be confounded with that form of inflammation which is characterised by the formation of a false membrane in the larynx, namely, croup or laryngeal diphtheria. If practicable, a laryngoscopic examination, showing the absence of false membrane, is the most certain means of diagnosing simple from pseudo-membranous laryngitis; but even where perfect casts of the trachea, bronchi, and primary bronchia were expectorated, the writer has seen the larynx absolutely free from false membrane, and simply inflamed. The absence of diphtheritic membrane in the fauces, of acrid excoriating discharge from the nostrils, and of glandular swellings, as well as the mode of accession of the symptoms, would lead us to regard the case as simple laryngitis; while the presence of any of these symptoms, or the prevalence of an epidemic of diphtheria, would lead us to suspect false membrane. Even after due consideration of these points, and of the character of the voice, cough, &c., in certain cases we are unable to say whether we have to deal

with simple, or with pseudo-membranous laryngitis. The stridulous laryngitis or false croup of children is further distinguished from true croup, by the sudden accession of the symptoms at night; by the *noisy* clanging character of the cough, as distinguished from the *husky*, suppressed, though possibly clanging cough of croup; by the similar absence of huskiness in the voice; and by the progress of the case, true croup or diphtheria increasing in intensity, while, from the first sudden onset of the symptoms, false croup diminishes, unless complicated with lobular pneumonia or other severe disease. From laryngismus stridulus acute laryngitis is distinguished by the presence of slight pyrexia, and other indications of primary inflammatory affection of the larynx and air-passages; by the absence of indications of any other affection of the nervous system, or of a tendency to convulsions; by the usual occurrence of the attack in the night only; by the slighter affection of the breathing; and by the frequent *croupy* cough, which is the prominent symptom, and which is wanting in laryngismus.

Prognosis.—In mild attacks of laryngitis all the symptoms exist only in a slight degree, and disappear in a few days under simple treatment. Such is the ordinary course of the false croup of children. In adults laryngitis may occur in any degree between the mildest form and that in which, the symptoms being all most intense, it may prove fatal in a day or two, or even in a few hours. The danger depends in great measure on the amount of œdema present, and this on the extent to which the submucous tissue is involved. Those cases which are consecutive to diffuse cellular inflammation of the neck, or to scarlatina or erysipelas, are most unfavourable; so also are those in which there is renal disease. Laryngo-typhus is especially fatal, as is also the œdematous laryngitis resulting from scald in children. Although mild laryngitis usually terminates favourably in a few days, it is necessary that every case should be sedulously watched, as at any period dangerous symptoms may set in and prove rapidly fatal. The disease is most deadly in the young. Acute may pass on to chronic laryngitis, and occasionally, but rarely, may cause chronic ulceration.

Treatment.—As soon as the first indications of even slight laryngitis are observed, the patient should be confined to a warm room; poultices should be applied to his throat; he should inhale the steam of either plain water, or of water containing a few drops of iodine; and small doses of liquor morphiæ hydrochloratis and liquor ammoniæ acetatis should be given every three or four hours, 4 or 5 minims of antimonial wine being added if secretion seem deficient. Should the symptoms increase in intensity emetics may be administered, and a blister should be applied on each side of the thyroid cartilage. The diet should be chiefly liquid; and, as a rule, no stimulants are required. Should the dyspnœa become urgent, tracheotomy must be performed; and this may be called for so suddenly, that as soon as a case of laryngitis comes under his care, the practitioner should be ready for the operation. After the trachea has been opened, the patient is to be kept with the same care in a warm moist atmosphere; a sponge continually changed and wrung out of hot water containing a little tincture of iodine should be kept in front of the tube; and the air should be warmed and moistened as it is drawn through the sponge, which also catches the secretions coughed through the tube. With due care in the performance of the operation and after-treatment of the patient, in cases of simple laryngitis, tracheotomy is almost always successful, but it should not be resorted to unless the case is urgent. Laryngoscopic examination will materially help the practitioner, who may live at a distance from his patient, as to the safety of leaving him without a tube in his throat. Circumstances may lead to the postponement of the operation until the patient is *in extremis*, but even then it should be resorted to. The writer has twice operated upon patients who were believed to have just died, with the effect of restoring them to life for some days, although in neither case was the result ultimately successful, both being cases of diphtheria, which killed the patients, notwithstanding the relief to the laryngeal obstruction.

Simple cases of false croup in children are usually relieved by warm poultices to the throat, or by an emetic, the last remedy being very effectual. Where *œdema* complicates laryngitis, very active treatment is required. In the slighter cases, the spray of a solution of 8 or 10 grains of tannic acid in an ounce of water, or of alum, 10 grains to the ounce, or of a saturated solution of chlorate of potash, should be inhaled; if the case is more severe, scarification by a long curved bistoury, with a cutting edge only at the point, will in most instances give relief. If by the laryngoscope the œdema has been proved to be infraglottic, scarification is not practicable. Should the symptoms become urgent, tracheotomy must be performed in such a case; and in any case of œdema, the urgency of the symptoms may decide the practitioner to prefer it to scarification. The treatment of traumatic œdema, the result of scald of the throat, is usually unsatisfactory; it must be surgical, by scarification or tracheotomy. Scarification is sometimes followed by severe hæmorrhage, and the surgeon who undertakes either this operation or tracheotomy, must be prepared to meet any emergency that may arise.

(*b*) **Chronic Laryngitis.**—Definition.—Low persistent inflammation of the mucous membrane and subjacent tissue of the larynx, occasionally confined to the glandular structures only.

Ætiology.—Specific forms of chronic laryngitis, to be separately considered, result from tubercle, syphilis, &c. The simple form almost always depends on exposure to cold, and the too early and frequent use of the voice, or other want of care, after acute laryngitis; it is also a definite result, according to Cohen and others, of over-feeding. The variety called 'follicular' or 'glandular' laryngitis depends on habitual overexertion of the voice, not unfrequently coupled with excessive use of alcohol or tobacco; it is a complaint of public speakers and singers.

Anatomical Characters.—The mucous membrane of the larynx is swollen and hyperæmic; the vessels are dilated, usually in patches; the

vocal cords are usually least affected, though they may present streaks of congestion; ulceration is rare in simple chronic laryngitis, but there may be abrasions of the surface. In glandular or follicular laryngitis, sometimes called 'clergyman's sore-throat,' the mucous membrane generally is but little thickened; but in the parts richest in glands, that is over the arytænoid cartilages, at the base of the epiglottis and parts of the ventricular bands, the racemose glands are hypertrophied; the surrounding vessels dilated; the ducts and cul-de-sacs enlarged, and their orifices closed, so that the secretions accumulate and sometimes escape by ulceration. Usually a similar condition of the follicles of the pharynx accompanies this form of chronic laryngitis.

Symptoms.—The symptoms of chronic laryngitis are hoarseness and aphonia after slight exertion of the voice; a hacking cough, with but little of the brassy, laryngeal character; either no expectoration, or only a little tenacious mucus; a sense of dryness, with slight pain in the throat; and occasionally dyspnœa on unusual exertion.

Complications and Sequelæ.—Very rarely ulceration may take place; or a sudden accession of acute symptoms with œdema may occur, and this may be followed by suppuration and necrosis of the cartilages.

Diagnosis.—In cases of chronic disease of the larynx a laryngoscopic examination is almost always practicable; without the laryngoscope, diagnosis and treatment can be only guesswork; with it the appearances described above are clearly recognised.

Prognosis.—Chronic catarrhal laryngitis may subside spontaneously, but is usually persistent unless properly treated. It may lead to permanent hypertrophy of the mucous membrane and thickening of the cellular tissue, and this may be general, or limited so as to resemble a tumour. It sometimes gives rise to warty growths. Glandular laryngitis is very obstinate. Neither form of non-specific chronic laryngitis is in itself dangerous to life.

Treatment.—Any imprudence in diet or hygiène must be corrected, and the voice rested as much as possible. About every other day the larynx should be brushed out with a solution of nitrate of silver, 40 grains to the ounce of water; and the spray of a solution of tannic acid and alum, or the steam of boiling water containing a drachm of tincture of iodine, or about 10 drops of fir-wool oil, dissolved in spirit, in the pint of water, should be inhaled three or four times a day. In obstinate cases, inhalations of the terebinthinate balsams, mixed with two or three times their bulk of ether, as recommended by Dr. Symonds, may be used, the warmth of the hand being sufficient to volatilise such solutions prepared according to his formulæ. Attention must be paid to the general health, and to the state of the digestive organs.

(*c*) **Tubercular Laryngitis.**—Synon.: Laryngeal Phthisis; Fr. *Phthisie Laryngée*; Ger. *Kehlkopftuberculose.*

Definition.—A specific inflammation of the larynx, depending on the presence of tubercle; accompanying, and sometimes preceding, tubercle of the lungs; and leading to destructive ulceration of the soft parts, and to caries and necrosis of the cartilages of the larynx.

Ætiology.—Pulmonary consumption may be complicated by simple laryngitis, but the disease specified above is itself tuberculous, its predisposing causes being those which favour the development of tubercle in persons of scrofulous constitution, and the exciting causes the same as those of simple laryngitis.

Anatomical Characters.—The majority of pathologists are agreed that, even in the earliest stages of tubercular laryngitis, minute deposits of miliary tubercle will be found; and these may generally be seen causing slight eminences, differing from the follicles in glandular laryngitis, in that from the first they become centres of ulceration of the mucous membrane. This destructive process extends to the deeper parts, involving the fibrous tissues; the articulations suppurate, and the ligaments and cartilages are destroyed; and prominent granulations and fungous growths occasionally spring from the ulcers near the vocal cords. The epiglottis is usually the first cartilage attacked, then the arytænoids and the cricoid, the last being the most liable to necrosis. Occasionally abscesses form, the necrosed cartilage being included in them; and ultimately every tissue of the larynx becomes involved.

Symptoms.—In tubercular laryngitis the symptoms specially dependent on the condition of the larnyx are hoarseness and weakness of the voice; cough, at first frequent and tickling, later husky, laboured, and ineffectual; difficulty in swallowing, often distressing, from the early affection of the epiglottis and upper parts of the larynx; expectoration, varying according to the extent to which the lungs are affected, and sometimes, in the later stages, including portions of cartilage; little difficulty of breathing at first, but later, from œdema, spasm, or great destruction of tissue, urgent dyspnœa, which may necessitate tracheotomy. To these symptoms, sooner or later, are usually added those of advancing pulmonary phthisis. A pale œdematous condition of the aryepiglottidean folds is usually the first indication of laryngeal phthisis observed with the laryngoscope; then swelling and ulceration of the epiglottis, followed by ulcers about the arytænoid cartilages. The view of the disease, as it extends lower, is usually prevented by the secretions, and the swollen condition of the epiglottis and upper parts of the larynx.

Complications and Sequelæ.—These have been sufficiently indicated in the description of the pathology and symptoms of the disease.

Diagnosis.—Tubercular must be diagnosed from simple chronic laryngitis by the early occurrence of œdema and ulceration; and from acute œdema by the mode of onset of the symptoms. From syphilitic disease the diagnosis is more difficult; there is no distinction in the appearance of the ulcers, but in syphilis there is less œdema, and the ulcers may heal, and present cicatrices. The detection of tubercle in the lungs, or other indications of the tubercular diathesis, will help to determine our opinion.

Prognosis.—Tubercular laryngitis is never

cured; but the rapidity of its progress may sometimes be checked. If it precede the deposit of tubercle in the lungs it may last in its early stage for years: if it supervenes on pulmonary consumption the downward progress is very rapid.

Treatment.—This must have reference to the diathesis on which the disease depends, and to its local manifestation. The constitutional treatment is fully discussed in the articles Phthisis, and Scrofula. The local treatment must be directed to mitigate the severe pain, and if possible to the cure of the disease. Rest must be obtained for the vocal organs, whilst the food should be such as to cause little inconvenience or pain in swallowing. Artificial feeding by enemata or even by the œsophagus tube may be needed. Soothing applications include ice and iced water; demulcent gargles (*see* Gargles); the insufflation of a powder composed of one grain of starch to 1-6th grain or more of morphia; or the application by the brush of a mixture of bismuth, gum, and 1-6th grain of morphia. Soothing inhalations of conium, benzoin, chloroform, or hops may also be used (*see* Inhalations). Occasionally, to promote the healing of ulcers, mild solutions of perchloride of iron, nitrate of silver, or sulphate of copper, may be tried. A leech or two over the larynx, followed by a poultice, may prove useful in some cases.

(*d*) **Spasmodic Laryngitis.**—Synon.: False Croup; Croup. Fr. *Laryngite ou Angine striduleuse*; Ger. *Pseudo-croup.*

Definition.—A mild degree of inflammation of the larnyx and air-passages; occurring chiefly in young children; accompanied by attacks of laryngeal spasmodic cough and breathing, which come on usually at night; and commonly terminating favourably in a few days.

Spasm of the glottis occurs as a purely nervous affection, as in laryngismus stridulus, but the complaint defined above is a variety of laryngitis; it is one about which practitioners are continually consulted, and is what mothers mean when they talk of a child being liable to croup.

Ætiology.—Any of the ordinary causes of catarrh will, in a child with a tendency to this affection, induce an attack. The age of the child is material in producing this tendency, as is also family proclivity; false croup occurring usually in children of from two to six or seven years old. It occasionally complicates the eruptive fevers, and especially measles.

Symptoms and Treatment.—A child, having previously shown signs of catarrh or slight bronchitis, and having probably been a little hoarse, wakes up suddenly from sleep with a clanging, spasmodic, not husky, cough, and with dyspnœa, characterised by the cooing sound with each inspiration which indicates spasmodic closing of the larynx, or by a complete spasm with convulsive movements of inspiration, lasting for a few seconds. The voice is not affected, or if altered it is not husky, but is simply emitted with difficulty, from the difficulty in regulating the action of the vocal cords. There is not more pyrexia than generally accompanies a severe cold. Under simple treatment the attack usually subsides, and the child drops asleep. The attack may be repeated on one or two following nights; but the first is usually the most violent, and that which most alarms the little patient and those around him. These are the symptoms of an ordinary attack of false croup, but its essential cause being some degree of inflammation of the air-passages, it is clear that this may go on to a severer form, and the child, first attended for false croup, may die from pneumonia or other inflammatory affection of the respiratory system, the symptoms produced by the severer affection of the lung combining with and complicating those dependent on the larynx. The persistent dyspnœa, and other symptoms, must in such a case be traced by the practitioner to their proper sources, or he may erroneously suspect and adopt treatment for graver laryngeal disease than actually exists.

(*e*) **Œdematous Laryngitis.**—Synon.: *Œdema glottidis*; Œdema of the Larynx; Fr. *Laryngite œdemateuse*; Ger. *Kehlkopfoedem.*

Definition.—Inflammatory exudation into the submucous areolar tissue of the larynx, of serous, sero-purulent, or sero-gelatinous fluid.

The exudation usually attacks first the aryepiglottic folds and the epiglottis, and it may extend thence to the ventricles and other parts of the larnyx, the vocal cords themselves being seldom affected. The submucous tissue below the vocal cords, lining the cricoid cartilage, may be the sole seat of the exudation; a form of œdema which has been attributed usually to a gouty constitution. Whether occurring in the course of acute laryngitis, or, as is more frequently the case, supervening on chronic laryngitis, œdema of the larynx is of the greatest importance, being least fatal when an accident of chronic disease. Œdema complicates laryngitis of an asthenic type, such as cases consecutive to the exanthemata, and is always present in the cases due to scalds from drinking boiling fluids. It is this form of laryngitis which occurs in persons labouring under Bright's disease, the œdema in these cases not being passive dropsy, but the result of inflammation.

Anatomical Characters.—The mucous membrane in œdematous laryngitis is rather attenuated than thickened, and but little injected, unless it occurs as a complication of the superficial form of inflammation. Especially in scalds there is but little hyperæmia; but there is death and vesication of the mucous membrane with excessive œdema.

Symptoms.—The symptoms indicative of laryngitis exist in an increased degree when this is complicated with œdema, the swelling of the epiglottis interfering especially with deglutition, and that of the aryepiglottic and ventricular bands causing very dangerous dyspnœa. By examination with the finger, and far better by the laryngoscope, we observe further the physical condition caused by the swelling. The epiglottis is felt, or seen, misshapen, rounded like a chestnut, or its two sides swollen so as to resemble two mucous bladders pressed together in the middle line; and, unless this hides the rest of the larynx, the aryepiglottic folds will be recognised as two long rounded swellings, passing

from before back, and nearly meeting in the centre, the swollen ventricular bands being visible only when there is little œdema above.

Treatment.—The treatment of œdematous laryngitis has already been described under the head of acute laryngitis.

4. Larynx, Lepra of.—Definition: A specific affection of the larynx, met with only in cases of lepra of long standing, and associated with a similar affection of the buccal mucous membrane, the tongue, and the palate.

Ætiology.—The causes are identical with those of lepra in other situations.

Anatomical Characters. — The disease spreads from the mouth to the epiglottis, which becomes thickened, and is fixed from the infiltration of its mucous membrane. Other parts of the larynx afterwards present the same anatomical changes. The tubercles may ulcerate and cicatrize.

Symptoms, Complications, and Diagnosis.—The symptoms of laryngeal lepra are those of chronic inflammation; and if the tubercles ulcerate, the ulceration is very slow, and not of the destructive character of syphilis. As lepra of the larynx occurs only when the disease of the skin has been long established, its diagnosis is clear. It usually exists for a long time, even years, before it ulcerates, and even after this it is very slow in its progress, and not fatal.

Treatment.—As in other forms of lepra, treatment is almost useless; the fissures and ulcers are said to be relieved by touching with solid lunar caustic. *See* Lepra.

5. Larynx, Lupus of.—Definition: A rare specific form of inflammation and ulceration of the mucous membrane of the larynx, always associated with lupus of the skin.

Ætiology.—The causes of this disease, and of lupus of the skin, are identical.

Anatomical Characters.—In lupus of the larynx great numbers of small red round papules are first formed. These become abraded; and the abrasions gradually form ulcers, which penetrate deeply into the substance of the epiglottis, being triangular in form, with the apex directed forwards. Similar ulcers are found at a later stage in other parts of the larynx.

Symptoms, Complications, and Diagnosis.—The symptoms of lupus of the larynx are those of chronic inflammation; but there appears to be no tendency to œdema or to those affections of the cartilages which occur in syphilitic and tubercular laryngitis, from which the disease is further distinguished by the peculiar form of the ulcers and the papules, and the presence of lupus of the skin. It lasts for many years.

Treatment.—Lupus of the larynx must be treated locally by caustics or the galvanic cautery; and constitutionally in the same way as other forms of lupus. *See* Lupus.

6. Larynx, Malignant Disease of.—The larynx is rarely the primary seat of cancer (except in the form of epithelioma), although it is frequently involved by the spread of the disease from the œsophagus, pharynx, and neighbouring parts. The disease occurs usually as a general infiltration of the tissues, and does not form a polypoid tumour. It gives rise to symptoms of dysphagia, and of laryngeal obstruction, added to those of malignant disease in other situations. The symptoms only occur when the larynx is either attacked primarily, or invaded secondarily, by the disease; mere mechanical pressure by growths external to it not interfering with its functions, although they may displace the organ to a very great extent.

Treatment.—The obstruction to respiration may demand the performance of tracheotomy; and if the lower part of the trachea is free from disease, the operation will prolong life. If the trachea itself is extensively affected, the insertion of the tube may increase rather than relieve the dyspnœa. Removal of a cancerous larynx was first practised by Billroth, and has since been performed by several Continental surgeons. The results of the operation have, however, been so unfavourable that it cannot be recommended in this form of disease.

7. Larynx, Paralysis of.—Definition: Loss of power in the laryngeal muscles, occurring in connection with disease or poisoning of the nervous centres, or with pressure upon or disease of the laryngeal nerves, caused by aneurism, enlarged cervical or bronchial glands, or other intrathoracic tumours.

Varieties and Treatment.—The commonest effect of disease of or pressure upon the recurrent laryngeal or motor nerve of the larynx is paralysis of the *ab*ductors, causing the vocal cords to approximate in the middle line, in a relaxed state. They are not tense even when an attempt is made to speak; and during respiration a narrow chink is left, with relaxed edges, causing very stridulous breathing and, possibly, fatal asphyxia. Paralysis of the *ad*ductors, unilateral or bilateral, when one or both vocal cords are seen at all times relaxed and drawn aside, is a consequence of disease of the superior laryngeal nerve, which supplies the cricothyroid and arytænoid muscles. These varieties of paralysis are readily recognised by the laryngoscope; and they usually cause aphonia, without necessarily dyspnœa. When these cases are of long standing, the muscles become atrophied as in other paralysed parts. The condition usually depending on serious disease without the larynx, treatment can be of little avail. Tracheotomy may be called for to avert asphyxia. Cases are recorded where the local use of electricity has cured paralysis, but these were probably cases like those previously described, where paralysis of the adductors is simulated. *See* 1. Aphonia; Pneumogastric Nerve, Diseases of; and Appendix.

8. Larynx, Polypus of.—Synon.: Growths of the Larynx; Fr. *Tumeurs, Kystes, et Polypes du Larynx*; Ger. *Kehlkopfpolypen.*

Definition.—A morbid growth attached to the walls of the larynx, and projecting into its cavity, in the form of a tumour.

Ætiology.—The invention and use of the laryngoscope, leading to accurate diagnosis, has established the fact that tumours of the larynx are of much more frequent occurrence than was formerly supposed. They are most common in adult males who habitually over-exert the voice;

but they occur in either sex, and at any age, from infancy upwards. Inflammatory attacks, syphilis, and anything leading to habitual congestion of the larynx, favour their development.

Anatomical Characters.—Growths of various kinds occur in the larynx. (*a*) *Papilloma*, or warty growth, having a base of connective tissue, and coated with epithelium, may occur either as a solitary separate filament, or a group of filaments, or as an agglomeration of little rounded eminences, the whole forming a perfectly defined tumour. It is frequently multiple; increases rapidly; has a tendency to recur when removed; and is of friable texture. It is most common at the anterior commissure of the vocal cords, but these growths may be attached all over the larynx.

(*b*) *Fibroma* is usually solitary, its size varying from that of a grape-seed to that of a pigeon's egg or more, either sessile or pedunculated, with a bright smooth surface, becoming lobulated as the tumour increases.

(*c*) *Mixed fibrous and fibro-cellular tumours, sarcoma*, and mixed *lipoma* and *fibroma*, externally resemble fibroma, their nature not being recognisable until after removal.

(*d*) *Adenoma*, or glandular tumour, is described by Türck as distinguishable from fibroma by its swelling, and altering in colour. It increases rapidly, and is of a dark pink colour at first, becoming whitish as it increases.

(*e*) *Myxoma*, or *mucous polypus*, is rare. It presents a smooth, moist-looking, semi-translucent, rounded surface; and, according to Brûns, consists of a slimy matrix, with intersecting fibrillæ, inclosed in the altered mucous membrane.

(*f*) *Cystic polypus* is usually the result of a change in some other tumour. It may, however, occur as a primary growth; and a case is recorded where such a growth caused the death of an infant, thirty-six hours after birth.

(*g*) *Epithelioma* is not uncommon, presenting the usual structure and appearance of epithelioma elsewhere.

Symptoms.—Polypus may cause absolutely no inconvenience. The most constant symptom is a modification of the voice. It usually excites dry cough, often spasmodic and croupy. The breathing is but little affected until the growth attains some size, when dyspnœa will set in, at first only on exertion, occasionally spasmodic; as the growth increases, it becomes constant, and at last fatal if the disease is unrelieved. Tumours attached below the vocal cords are rare; when they exist, and are large enough to interfere with the breathing, expiration is as noisy and difficult as inspiration. These growths are usually painless; they may be so situated as to interfere with swallowing, but this is not usual. In addition to these symptoms, the growth can be seen with the aid of the laryngoscope, and felt with the laryngeal probe or sound, and sometimes with the finger. Occasionally portions of a papilloma are expelled by coughing.

Diagnosis.—A certain diagnosis can only be arrived at by a physical examination, unless, indeed, portions of the growth are expectorated. Most forms of growth may be diagnosed by their appearance in the laryngoscope. The point and extent of attachment may be determined by the skilful use of a laryngeal sound or probe.

Prognosis.—The importance of these growths varies with their situation and rate of increase. A few months have sufficed for the growth of tumours, from their origin to their attaining a size sufficient to threaten suffocation; in other cases they may exist for years without giving rise to any symptom beyond dysphonia or aphonia. As soon as a polypus causes dyspnœa, it has become dangerous. Although a polypus under observation for some time has been seen to grow smaller, and cases occasionally occur where the more friable variety is spontaneously expelled, the disease must practically be regarded as incurable, except by operation or other local treatment.

Treatment.—A small stationary fibroma or other tumour, giving rise to but little inconvenience, requires no treatment. Small papilliform growths are amenable to treatment by strong caustic solutions. Almost all other tumours must be removed by operation. Removal may be effected by instruments introduced into the larynx from above with the aid of the laryngoscope; or, where the disease is very extensive, an artificial opening into the larynx (thyrotomy or division of both thyroid and cricoid) may be necessary, the growth or growths being removed through this opening. If the growth is removed *per vias naturales*, it may be crushed through at its base by a properly constructed écraseur; it may be seized and torn off by forceps; or it may be cut off by knives or scissors. The particular operation, and the instruments to be used, must be determined by the circumstances of the case. Tracheotomy may be necessary as a palliative measure, where, for some reason, a curative operation cannot be adopted; or it may be required as a preliminary to the radical operation. Where the choice lies between tracheotomy and an operation for removal of the tumour, the latter must always be selected. Removal of the larynx for recurrent sarcoma has been successfully practised in this country by the late Dr. Foulis; and the operation is available where milder measures for the cure of these growths prove ineffectual. After extirpation the voice can be restored by the insertion of an artificial glottis.

9. **Larynx, Spasm of.**—In the description of other diseases of the larynx, this has been referred to as a frequent and often fatal complication. Spasm is a most urgent symptom when the larynx is irritated by the lodgment of a foreign body or other irritant. It may result from pressure on, or disease of the pneumogastric nerve; from hysteria; and as a manifestation of a more general affection of the nervous system, in which case it constitutes the following special malady.

Laryngismus stridulus.—Synon.: Child-crowing; Spasmodic croup; False croup; Fr. *Spasme de la glotte*; *Pseudo-croup nerveux*; Ger. *Kehlkopfkrampf.*

Definition.—Short or more prolonged accessions of suffocation; depending on tonic spasm of the adductor muscles of the larynx, and usually of the diaphragm and other respiratory muscles; causing closure of the glottis, and a sudden arrest

of inspiration; and ending in a shrill crowing sound, as the inspiratory act is resumed and concluded. It is unaccompanied by any inflammatory affection of the larynx or air-passages; and is often associated with other convulsive affections.

Ætiology.—Anything causing excessive reflex irritability, rachitis, chronic hydrocephalus, and other organic affections of the brain or medulla oblongata, predispose to this convulsive affection. It is undoubtedly sometimes associated with chronic enlargement of the thymus; and with the irritation of teething. A sudden fright, irritation of the larynx by the accidental entrance of food, or some such slight agitation as that caused by a child being tossed in the air, may excite the attack.

Anatomical Characters.—This is purely a nervous disease, and there is no anatomical change in the larynx.

Symptoms.—With or without premonitory indications of a tendency to convulsive affection, such as drawing in of the thumbs and great toes, or clenching of the hands; often during sleep, and with no evident exciting cause, or at any time in the day; a child is suddenly attacked with difficult breathing, inspiration being accompanied by the crowing sound characteristic of laryngeal spasm. This may continue for some time, and then gradually subside. The spasm may be short, or it may be longer and more intense, inspiration being proportionately difficult. It may be complete, and the act of inspiration cease entirely, until just as death seems imminent, the spasm relaxes, and with a crowing inspiration breathing is re-established. In the worst cases, and sometimes in the first attack, death does actually occur.

Diagnosis.—The diagnosis of this disease from stridulous laryngitis or real false croup, with which it is in this country frequently confounded, and that even by recent authors, is considered under 3. *a*, Acute Laryngitis. The symptoms caused by a foreign body lodged in the larynx closely simulate laryngismus stridulus. The nature of the case is decided by its history; and, unless the age of the patient precludes it, by a laryngoscopic examination.

Prognosis.—The milder forms of this malady yield to suitable treatment, and disappear as improvement takes place in the condition inducing the attack. Severer forms, if not fatal in a first, may be so in a subsequent attack. When the spasm depends on some incurable organic change in the nervous system, the case is of course hopeless from the first.

Treatment.—Attention to the diet and general management of the child, regular bathing, and the administration of remedies suitable to correct faults of digestion, are necessary. The persevering use of bromide of potassium has been found beneficial by the writer; and chloral hydrate is of undoubted value. For the immediate treatment of the spasmodic attack, prompt immersion in a warm bath, the administration of an emetic, or the use of an anæsthetic vapour may be resorted to; and should breathing not be re-established as the spasm ceases, dashing cold water on the face and chest, friction, application of strong ammonia and vinegar to the nostrils, and especially artificial respiration, must be adopted, with the object of restoring the function. Tracheotomy may be requisite, but the practitioner is, unfortunately, seldom present when the indications for the operation arise.

10. **Larnyx, Syphilitic Disease of.**—Syphilis affects the larynx differently according to the stage of the disease at which the organ is attacked. Erythematous maculæ, raised mucous patches or condylomata, and superficial ulceration, like that seen in the fauces and pharynx, may occur as secondary symptoms; but the larynx is more commonly and more seriously affected in advanced stages of syphilis. It may then be the seat of small tubercles, varying from the size of a millet-seed to that of a pea; or ulceration may occur, following upon an eruption or upon gummata. The ulcers are usually multiple, deep, and sharp-edged, presenting much the appearance of tubercular ulcers; and the cartilages are frequently necrosed. Sometimes the disease begins with perichondritis, leading to suppuration and subsequent caries and necrosis of the cartilages, external fistulæ occasionally communicating with the diseased larynx.

Symptoms.—Secondary syphilitic affections cause hoarseness and sometimes loss of voice, with some harshness of breathing, but there is usually neither pain, cough, fever, nor much dyspnœa. The more serious tertiary affections may give rise to all the symptoms caused by tubercular ulceration, but the constitutional symptoms are those of syphilis, as distinguished from consumption.

Complications and Sequelæ.—Although amenable to treatment, and therefore curable, syphilis is more liable than any other affection of the larynx to leave serious consequences. Not only are the cicatrices of the healing ulcers liable to contract the opening of the larynx, and to cause adhesions which may permanently obstruct respiration, but the specific deposits occasionally occur in such a form, that even without ulceration, they produce stenosis or contraction of the larynx or trachea. Tumours of the larynx appear sometimes to result indirectly from syphilis; and, as just mentioned, aërial fistulæ may be left after necrosis of the cartilages.

Diagnosis.—The secondary affections of the larynx are easily recognised in the laryngoscope, and there are usually other indications of the constitutional taint. Syphilitic must be distinguished from tuberculous ulceration by the concomitant symptoms of the disease, the presence of gummatous tumours, and the occurrence of cicatrisation of the ulcers; the œdema and general thickening are also less than in tubercle. From ulcerated epithelioma it may be distinguished by the history; by the fact that the cancroid growths usually extend from the pharynx and œsophagus to the larynx; by the cancroid ulcer being solitary, while syphilitic ulcers are usually multiple; and by the appearances of the sores and their base. Frequently in these cases the amount of secretion prevents a satisfactory view of the parts, and our diagnosis must then be arrived at without the aid of the laryngoscope.

Prognosis.—The prognosis in cases of laryn-

geal syphilis must vary according to its form, but unless the case is complicated by some other vice in the system, we may hope to cure it by appropriate treatment. If left to itself, the tertiary form of the disease will probably ultimately destroy the patient. Where it occurs in a person of scrofulous constitution, the prognosis will be less favourable; and if to this be added abuse of alcohol, and irregular living, the chances of recovery are small. At any period of this, as of other laryngeal disease, sudden urgent symptoms are liable to arise, resulting in a fatal termination, a consideration which must induce us always to give a guarded opinion.

Treatment.—Local treatment is seldom necessary for the secondary syphilitic affections of the larynx, and we must trust to mercurial inunction and other constitutional remedies. Should a mucous condyloma, from its situation, affect the voice or breathing in a very grave degree, a solution of bichloride of mercury, one grain dissolved in a drachm of weak spirit, may be carefully applied with a brush. Syphilitic ulceration of the larynx requires persevering treatment by iodide of potassium; and where it does not yield to this remedy, appropriately combined with quinine, cod-liver oil, &c., mercury must be employed, the best method being by mercurial inunction, or the hypodermic injection of the bichloride. A prolonged course of the drug being necessary, the patient must pay great attention to his mouth, sucking alum frequently, so as to avoid ptyalism. The local application of a solution of 10 grains of sulphate of copper to the ounce, and touching isolated ulcers with solid nitrate of silver or sulphate of copper, will be beneficial; astringent, sedative, or other medicated, and especially iodine, inhalations should also be employed. In old cases of syphilis, warty growths are sometimes seen in the larynx, which may be cured by frequent topical applications, combined with constitutional treatment. When the dyspnœa is dangerous, tracheotomy must not be delayed. It will usually prove successful, although the destruction of tissue and cicatrisation may be such as to necessitate the permanent wearing of the tube. Operations for the division of cicatricial bands and adhesions may be required. They should be undertaken only by a skilful and practised laryngeal operator. Two or three cases have been operated upon successfully, where the vocal cords were united in their whole length by a web of adhesions. Heine has removed the larynx for stenosis resulting from syphilis; but extirpation must not be adopted where tracheotomy is available.

Thomas James Walker.

LATENT (*latco*, I lie hid).—This word is applied to cases of certain diseases in which their usual characteristic features are obscured and concealed; for example, *latent pleurisy*, *latent scarlatina*. Symptoms are also said to be latent when they do not occur under circumstances in which they ought to appear. For instance, *cough* may be *latent* in certain cases of phthisis.

LEAD, Poisoning by.—Synon.: Plumbism; Fr. *Intoxication saturnine*; Ger. *Bleivergiftung*.

Pure metallic lead has probably no injurious action on the system; but owing to the ease with which it oxidises and forms salts, all of which are poisonous, lead-poisoning is of common occurrence amongst all persons whose occupation brings them much in contact with metallic lead and its alloys; among those engaged in industries in which lead-salts are manufactured or largely employed; as well as from contamination, accidental or otherwise, of articles of food, drink, or luxury, with lead or its compounds.

Acute poisoning with lead is not common, nor are any of the lead salts actively poisonous. The acetate or sugar of lead is popularly believed to be a virulent poison, but it is by no means so. There are very few fatal cases on record, even from swallowing quantities amounting to an ounce of the acetate or its equivalent. The symptoms are in the main those of irritant poisoning, the chief difference being that constipation is the rule, and diarrhœa the exception.

The *chronic* form of poisoning by lead is of infinitely more importance and prevalence. The sources of it are extremely numerous and varied, and it is almost impossible to specify all individually. The following are among the chief, classified according to the primary form of the poison.

1. **Metallic Lead, Poisoning by.**—Lead-poisoning occurs among lead-miners, metallurgists, and workers in lead or its alloys, such as plumbers, solderers, type-founders, compositors, and manufacturers of lead toys (toy-soldiers). It has been observed also among fishmongers, from using lead counters; in pot-boys; as the result of packing articles of food or luxury in lead-foil; and from contamination of articles of drink by shot used for cleaning bottles, siphon soda-water bottles, &c.

Under this head may also be included the very frequent contamination of *drinking water* by lead pipes and cisterns. Pure water, freed from gases and excluded from contact with air, does not act upon lead, but in presence of air the lead becomes speedily acted on, and the water contaminated. An oxide of lead is formed, which being partially soluble in water, allows the action to go on. From its solution the oxide is in great measure precipitated by carbonic acid, which is absorbed. The lead falls as an oxycarbonate, though the presence of carbonic acid in the water keeps a certain quantity in solution. The purer the water the more rapid the action. The presence of certain salts in the water considerably modifies its action on lead. Thus the nitrates, nitrites, and chlorides, by forming soluble compounds with lead, increase the solvent action of the water; and as these salts usually result from sewage-contamination, such water is rendered still more dangerous by passing through lead pipes. Other salts, usually found in spring and river waters, act as protectives by forming insoluble lead-compounds, which being deposited as a crust in the interior of the pipe or cistern, prevent further action. Of this class are the sulphates, phosphates, and carbonates. Hence waters, unless containing much less than the average proportion of lime-salts, after a time cease to be contaminated to any great extent, though the presence of carbonic acid in the water

renders a solution of the crust possible in some measure. Waters so deficient in lime-salts as the Loch Katrine water supplied to Glasgow cannot safely be conveyed in lead pipes. Galvanised iron, earthenware, or slate may in many cases be advantageously substituted for lead, if not possible in all. Lead covers to cisterns are very objectionable, as the water which rises by evaporation condenses and drops back contaminated. The electrolytic action of solders also helps to contaminate water with lead.

2. **Oxides of Lead, Poisoning by.**—The most important oxide of lead in this relation is litharge or plumbic oxide (Massicot), which is largely used in making glass and glazes for earthenware and iron. Those engaged in glass-making and grinding, glazing, pottery, &c., suffer. Owing to the solubility of lead-glazes, articles of food if acid may be contaminated. Litharge is also used for hair-dyes, japanning, &c., whence poisoning may result.

The 'red lead,' which is a mixture of lead oxides, has caused poisoning, by being used to colour wafers, adulterate snuff, and make putty or cement for tanks, &c.

3. **Lead Salts, Poisoning by.**—Of these the most important in this relation is the carbonate, or 'white lead.' Those engaged in the manufacture, grinding, and packing of white lead are the most frequent sufferers, and also those who largely use it, such as painters, glaziers, plumbers, glazed card manufacturers, lacquerers, lace manufacturers, and those who apply it as a cosmetic (clowns, &c.). The acetate of lead has been used for correcting the acidity of wine and cider, and has been a frequent source of lead-poisoning. Poisoning has also occurred among seamstresses from using silk thread adulterated with it; in dye-works, where it is largely used; from using it as a hair-dye; and from long-continued medicinal administration. Lead colours, chromates, &c., have also caused poisoning, by being used to colour confectionery. From these and similar sources lead may be introduced into the system by inhalation, ingestion into the stomach, and apparently also by cutaneous absorption.

Symptoms.—The affections caused by lead are frequently termed *saturnine*, owing to lead being the symbol of Saturn, the malign planet of the astrologers. They are of a manifold character, and do not always occur in regular order or sequence.

Saturnine cachexia.—As a rule, after long-continued introduction of lead into the system, a saturnine cachexia is developed, characterised by anæmia, an earthy or dull hue of the skin, digestive derangement, dryness of the mouth, frequently a styptic or sweetish astringent taste, coated tongue, and fetid breath. The teeth are discoloured, and frequently appear elongated from retraction of the gums. At the margin of the teeth and the gums a bluish or violet line is developed. This, which is regarded as the specially diagnostic indication of lead-poisoning, was first described by Burton, and is shown to be due to the formation of a lead sulphide in the parts.

Lead Colic.—Synon.: *Colica Saturnina*; Fr. *Colique de Plomb*; Ger. *Bleikolik.*—Following the symptoms just described, but sometimes without marked prodromata, a very characteristic affection occurs, namely, lead colic. This is known by many other synonyms, of which the more common are Painter's colic, Devonshire colic, Colica Pictonum, the last being derived from the inhabitants of Poictou, among whom in modern times it was first extensively prevalent, owing to adulteration of wine with lead-salts.

Patients affected with lead colic exhibit a cachectic look, earthy hue, blue line on the gums, coated tongue, and fetid breath; and suffer from nausea and, occasionally, vomiting. The bowels are obstinately confined, or scanty hard motions are passed with difficulty. Paroxysms of excruciating pain occur in the abdomen, which feels hard, and is retracted in the region of the umbilicus. The pain is of a truly colicky nature, and is relieved by pressure. The countenance is anxious, and the skin is covered with cold perspiration. The respiration is shallow, and the pulse generally slow and hard, though this is not always the case. The urine is not unfrequently almost or entirely suppressed.

Lead Palsy.—Synon.: Fr. *Paralysie saturnine*; Ger. *Bleilähmung.* After repeated attacks of lead colic, or it may be after one, and sometimes without antecedent colic, various other affections occur. One of the most common of these is a form of paralysis termed lead palsy, or, from its special features, 'dropped wrist.' The paralysis shows itself more particularly in the extensor muscles of the forearm, or region of distribution of the musculo-spiral nerve; and in consequence, when the arm is raised, the hand drops by its own weight. The paralysis generally commences in the extensor digitorum communis, and gradually extends to the other muscles supplied by the musculo-spiral, with the remarkable exception of the supinator longus. The paralysis does not necessarily confine itself to the forearm, for in advanced cases it may attack other muscles in the arm, the muscles of the leg, and the dorsal muscles; showing itself by preference in the extensor muscles of the body, and giving rise to a peculiar stooping, tottering gait. Aphonia occasionally results. The paralysed muscles undergo atrophy, and ultimately cease to react to faradisation or galvanisation, the faradic excitability being lost before the galvanic, as in peripheral paralysis generally.

Other phenomena.—Tendinous swellings of an oval or elongated shape frequently form on the tendons at the back of the wrist, and contrast prominently with the atrophied muscles. Neuralgic pains in the muscles and joints are often complained of. In the more advanced cases various forms of encephalopathies occur. Epileptiform convulsions are common; and psychical affections are not unfrequent, in the form of delirium, mania, or melancholia. Apparently in causal relation with lead-poisoning, disease of the kidneys and albuminuria may occur; and gout is frequently seen among those who work in lead. Abortion occurs to a large extent among women employed at white-lead works; according to Paul, in the proportion of sixty per cent. of those so employed.

The tendency is to recovery, if the cause of the symptoms is removed; but if not, the paralytic

and other affections become incurable, and death occurs in a miserable state of cachexia.

Anatomical Characters.—There are no very characteristic appearances of chronic lead-poisoning. Lead is found in almost every organ and tissue in the body, the greatest quantity, according to Heubel, being found in the bones; next in the kidneys, liver, brain, and spinal cord; and to a less extent in the muscles.

Among the appearances which have been described are constriction and apparent thickening of the muscular coats of the large intestine; and an atrophic condition of the intestinal mucous membrane has been found by some authors (Kussmaul and Maier). These authors have also found an increase of the connective tissue, and atrophy of the nervous tissue in the abdominal ganglia of the sympathetic. The paralysed muscles exhibit atrophic degeneration, with hyperplasia of the connective tissue, and disappearance of the striæ, and the nerve-trunks likewise exhibit various stages of atrophy. We possess, as yet, no very reliable knowledge of the condition of the nerve-centres. The subject is one still requiring much investigation.

Pathology.—The mode of action of lead, and the causation of its characteristic symptoms are subjects still under discussion. Henle is of opinion that lead acts primarily on the non-voluntary muscular fibres throughout the body, while Heubel thinks that the primary action is on the nerve-centres. From this, as secondary consequences, are deduced the colic, due to irritation by compression of the intestinal nerves, and the constipation from cessation of the intestinal secretion by contraction of the blood-vessels. To the arterial ischæmia so produced the paralysis is attributed (Bärwinkel). Hitzig thinks that the paralysis of the extensors is due to a peculiar disposition of the veins, which favours the deposition of lead there. This is a mechanical theory which has little to support it except a dilated condition of the veins, and is utterly insufficient to account for the occurrence of paralysis in other regions, besides being in contradiction to the fact that lead is not specially deposited in the muscles, as this theory would necessitate. That the paralysis is due to degeneration of the nerves is in harmony with the symptoms and electrical reactions of the muscles, and is supported by the post-mortem appearances; but whether the peripheral degeneration is primary, or secondary to central degeneration in the anterior horns of the spinal cord, is not as yet satisfactorily determined.

Treatment.—In *acute* lead-poisoning from any cause the stomach must be emptied by the stomach-pump, or by emetics—of which sulphate of zinc is to be preferred. Solutions of the alkaline or earthy sulphates—of which the best is sulphate of magnesia—are indicated, with the view of forming the comparatively insoluble sulphate of lead, and expelling it from the intestines.

As regards *chronic* poisoning by lead, prophylaxis is the most important consideration. The great principles in lead-works are the inculcation of cleanliness; avoiding eating with unwashed hands, or in working clothes, or in workshops; moist grinding; free ventilation; precautions against dust rising, or wearing of flannel respirators where it is unavoidable; and occasional doses of sulphate of magnesia, acidulated with sulphuric acid. Sulphuric acid lemonade has been recommended as a drink.

Workmen who begin to show signs of lead-poisoning should at once give up the work, and take to some other employment. As regards water-contamination, what has already been said on this subject will suffice to indicate the prophylactic measures.

In the treatment of lead colic, purgatives are indicated, and opium may be necessary to allay the excruciating pain. The sulphate of magnesia is the best purgative. Iodide of potassium is generally given with the object of removing the lead from the system, and is on the whole satisfactory in its results. A combination of the iodide with sulphate of magnesia is very beneficial. Sulphur baths are also recommended.

The local paralytic affections require local, in addition to the general treatment. Unless the muscles are in an advanced state of atrophy, and give no response to electrical stimulation, good results may be obtained by the use of the galvanic current applied to the muscles and to the musculo-spiral nerve. Faradisation has also been found beneficial, and is recommended by Duchenne, but the preference is to be given to the continuous current. D. Ferrier.

LEAMINGTON, in Warwickshire.—Sulphated common salt waters. *See* Mineral Waters.

LEECHING. — The local abstraction of blood, by means of leeches. *See* Blood, Abstraction of.

LENS, Diseases of. *See* Cataract.

LENTIGO.—A synonym for freckle. *See* Freckles.

LEPIDOSIS (λεπὶς or λέπος, a scale).—A term adopted by Mason Good to distinguish the group of squamous affections of the skin; amongst which is included lepra vulgaris or lepriasis. The term is now obsolete.

LEPOTHRIX (λεπὶς or λέπος, a scale, and θρὶξ, a hair).—Definition.—A term applied to a hair in which there is loosening and partial detachment of the overlapping edges of the scales of its cuticle.

Such hairs are usually met with in the axilla, and their peculiar conformation is attributable to the heat and dampness of that region, which causes maceration of the hair, particularly when it is of feeble structure. Sometimes the scales completely surround the hair; very commonly one side of the shaft is more affected than the rest, and presents the appearance of a fringe; and not unfrequently the scales are roughened with earthy and saline crusts deposited by the sweat.

Treatment.—The treatment most suitable for this evil is saponaceous ablution, followed by the use of a lotion composed of two to four drachms of oxide of zinc to half a pint of lime-water. Erasmus Wilson.

LEPRA (λεπὶς or λέπος, a scale).—The term lepra was used in the plural, λέπραι, by Hippocrates, to imply its constitution of multiple

patches. Willan adopted the term as significative of a squamous eruption, and in this sense it has been regarded as the lepra Græcorum. The foreign schools, however, prefer to name it psoriasis, a term now commonly associated with it in Great Britain; whilst they assign the word 'lepra' to the elephantiasis of the Greeks, the so-called 'true leprosy.' Hence whilst the operation of time has transferred the word 'psoriasis' to the lepra of the Greeks, it has conveyed the term 'elephantiasis' of the Greeks to the lepra of the Arabs; and common consent reserves the word lepra or leprosy for the elephantiasis of the Greeks. Thus, the terms, lepra, psoriasis, elephantiasis græcorum, and leprosy are somewhat confusedly intermingled, and one mode of extrication from the dilemma would appear to be to consider lepra as synonymous with leprosy, and to abandon its use in connexion with the lepra of the Greeks, now termed psoriasis; although the adoption of Mason Good's term 'lepriasis' would no doubt be the better alternative. For himself, however, the writer prefers the more classical course of retaining the term 'lepra,' the type of roughness, for the lepra Græcorum and the lepra vulgaris of Willan; giving to genuine leprosy, the great disease, its Greek designation, elephantiasis; and attaching psoriasis to squamous eczema, the 'psora' of the ancients, to which it properly belongs. The elephantiasis Arabum or 'elephant leg,' must be left out of consideration, as being an error of nomenclature, taking its origin in a blunder of translation of the Greek writings by the Arabian authors. *See* Elephantiasis Arabum.

Erasmus Wilson.

LEPROSY (λεπρὸς, rough).—Derivation and Synonyms.—The term leprosy had its origin at a time when diseases of 'roughness' comprehended a large majority of affections of the skin; and it was, in fact, a generic name for 'skin diseases.' Hence the indefiniteness of the word as we meet with it in the Bible, where 'leprosy' in one connexion represents a trivial disorder, and in another a serious disease; and in a similar sense, a leper, in many instances, was nothing more than a person afflicted with a cutaneous complaint. In modern times leprosy has been found a convenient designation for that terrible disease described by the Greek fathers of medicine as elephantiasis—a disease widely spread over the world, and, according to the saying of Aretæus, so much greater than the rest of diseases as the elephant is bigger than all other animals—a disease which is universal in its diffusion through the frame, and in which all the tissues of the body are implicated to a greater or less extent. The terms *leprosy* and *lepra* are consequently quite distinct from each other; leprosy and elephantiasis being synonymous; whereas the term lepra, or rather λέπραι, in the plural, was applied by the Greeks to scaly white spots of the skin, a disease of roughness as in elephantiasis, although a disease of roughness in a very different sense. But the analogy of the two words, both in derivation and sound, has given rise to some confusion, and the confusion is increased by a misapplication of the term elephantiasis. Thus we find that whilst the elephantiasis of the Greeks has the signification of leprosy, the lepra of the Greeks is a trivial affection, sometimes styled lepra vulgaris, and very commonly, although erroneously, psoriasis. The word elephantiasis has also been applied to a local disease of hypertrophic growth known as elephantiasis Arabum; whilst the Arabians, amongst whom leprosy is also found, call that disease lepra. It therefore follows that leprosy, elephantiasis Græcorum, and lepra Arabum are synonymous terms.

The synonyms of leprosy are numerous, as may be inferred from the extensive distribution of the disease throughout the world, and its identification in different countries by different names. Amongst the most important of its synonyms are:—*Elephantiasis; Lepra; Lepra elephantia; Black Leprosy; Red Leprosy; Elephantiasis tuberosa, anæsthetica, nodosa, mutilans, leontina, satyria; Joint-evil; the Myckle Ail* or *Great Disease*, its English name in ancient times; *la Lèpre* in France; *der Aussatz* in Germany; *Spedalskshed*, throughout Scandinavia; *Likpra* in Norway; and so forth.

Geographical Distribution.—The countries in which leprosy prevails most extensively are:—Hindostan, China, the islands of the Indian Ocean, some of the Polynesian Islands, Madagascar, Africa, the West Indies, parts of South America, Norway, Sweden, and parts of Canada. Therefore, although most abundant in hot climates, it is likewise frequently met with in the North. For thirteen centuries it was endemic in Great Britain; the last case still lingered on the borders of Scotland so late as the beginning of the nineteenth century; now an indigenous example is nowhere to be found in the British Islands.

Ætiology.—The cause of leprosy is endemic. The disease has been met with from time immemorial in certain countries and localities; therefore the cause must be one which will be capable of abiding in different countries and in different climates—climates as various in character as the northern regions and the tropics. Time was when leprosy prevailed in Great Britain, and it took up its abode there for thirteen centuries; but the disease has gone, and therefore we may presume that the cause has ceased. Whether it has ceased in consequence of drainage and more general cultivation of the soil, is a question to be carefully considered. Hitherto indigenous leprosy has been unknown in the Australian colonies; but a well-marked case of elephantiasis tuberosa has recently come under the writer's attention, having its origin in New Zealand. The patient was a man of distinguished note in Australia; he had been draining very extensively in New Zealand, and he had lived for several years amidst the exhalations of the fresh-opened soil of the marshes. The example is not solitary. An English lad was born and brought up on the verge of a marsh in the West Indies. He was sent to London on account of debility; the diagnosis was elephantiasis. A few years afterwards, his father, an officer of police, followed him home, a victim of the same disease, which had become developed since the departure of his son. The writer could multiply cases of this kind considerably, and has had the conviction

forcibly borne in upon him, that the cause of leprosy is miasma. No other cause is of such general distribution, suiting every climate and every part of the world, unless it be such countries as have been relieved of the cause by land-culture and improvement. Leprosy has been assumed to be caused by bad food, and by a fish diet. There can be no doubt that an improper diet may be quite equal to the production of debility and disease, and might predispose, like any other lowering course, to the invasion of a miasma; but the disease prevails amongst the well-nourished as well as amongst the ill-nourished, and in countries where fish is rarely or never eaten; whilst fish in moderation must be regarded as a most healthful and nutritious article of diet. Leprosy is now believed to be hereditary, and it has the character of being non-contagious. Nevertheless there are some curious histories on record of the first appearance of leprosy in a population after the immigration of foreigners from a leprous country, as in the example of the importation of negroes into the district of Surinam in South America, and the origin and spread of the disease among the Sandwich Islanders after an immigration of the Chinese. This and other questions of cause must still remain unsettled until further information is obtainable. A specific form of bacillus has recently been found in leprosy, the lymphatics being believed to be the channels of infection. See *Lancet*, July 30, 1881.

Anatomical Characters.—The morbid anatomy of leprosy centres chiefly in the integument and in the nervous system. Danielssen and Boeck found the sheaths of the cutaneous nerves thickened and distended with exudative deposits, and similar changes were seen in the spinal cord. They also discovered tubercular matter in several of the internal organs, glands, and viscera. Virchow is of opinion that the pathological element of elephantiasis differs in no essential respect from that of the gummata of syphilis, nor indeed from that of lupus and glanders. Granulation-tissue is the characteristic element of all the three; the granulation tumour of elephantiasis is, however, more permanent than others of the same class, and tends in a less degree to degeneration and softening. Dr. Moxon, in a well-marked case of elephantiasis tuberosa that fell under his examination in Guy's Hospital, regarded the pathology of the disease as especially evinced by the integument, which he found atrophic and disorganised, the nerves apparently healthy, but the cutaneous nerves and veins alike involved in dyscrasic degeneration. 'We are struck,' he observes, 'with the small amount of morbid change proper to elephantiasis. The immediate cause of death was amyloid or lardaceous disease of the alimentary canal, liver, kidneys, and spleen, with marasmus in the most extreme degree, occurring as in other lingering but not otherwise mortal maladies.' *See* Bacilli, in Appendix.

Symptoms.—Leprosy makes its beginning so lightly and so unobtrusively, that it is perhaps rarely detected in its earliest stage. At that period there might, after close examination, be discovered a few symptoms of debility, such as weariness, chilliness, failure of appetite, sleeplessness, and lassitude. But these symptoms subside after a while, and the patient recovers his wonted energy and power; some months later similar symptoms return, but somewhat intensified; and several such recurrences may be experienced before any more obvious symptoms are made evident. The symptoms resemble those produced by malarious poison, and may be regarded as indicating the incubation of the leprous virus.

These premonitory symptoms of leprosy acquire force after repeated recurrence; and then two other symptoms make their appearance, namely, a hyperæmia of the skin, and a defective sensibility of the peripheral branches of the spinal nerves. The hyperæmia of the skin generally assumes the form of circular spots, sometimes of uniform size, at other times of blotches of irregular shape and varied extent. The isolated spots appear commonly on the trunk of the body and fleshy parts of the limbs, whilst on the face and neck, and on the hands and feet there is an uniformly diffused redness. What has already been said with regard to the progressive development of the constitutional symptoms must be repeated with respect to the local signs of the disease. At first only the face, hands, and feet may be congested, with a few spots on the trunk of the body. Then the hyperæmic congestion will subside and remain quiescent until another exacerbation of the leprous fever is imminent, when the spots will be increased in number and deepened in colour.

The redness of leprosy is dull coppery or purplish in tint; as it subsides it leaves on the skin a pigmentary stain; the affected integument is puffy with serous infiltration; the pores are dilated as if from hypertrophy of the follicles; and in general appearance the skin resembles the rind of an orange. At a more advanced stage of the cutaneous disorder the hyperæmic congestion becomes centrifugal, and the circular spot is developed into a ring; even the pigment disappears from the centre of the blotch, leaving a bleached centre surrounded by a belt which is slightly tumid, of a dull red hue, and deeply pigmented. Eventually the whole of the affected part may be represented by a white blotch. Blotches of all the three kinds may be seen at the same time dispersed over the body, some being red only, some melasmic, some leucasmic, according to their age; and others of irregular figure, arising from the blending of the circular spots, or spread out into rings of various extent.

The distribution of the maculæ or blotches of leprosy on the surface of the body corresponds with the nerve-territories of the integument, and the same may be said with regard to the face, and the extremities below the elbows and knees. On the face the parts specially affected are the superciliary regions, the nose, and the ears; and on the arms the territory of the ulnar nerve. In all these regions the blotches soon become blended; and the redness, pigmentation, and infiltration are more general than elsewhere. The suffused redness of the skin has suggested the term elephantiasis erythematosa; and this state of congestion is frequently accompanied by prominence of the follicles, and more or less desquamation and exfoliation of cuticle. In some

situations the hyperæmic blotches are moistened by a greasy exudation; in others they are dry, parched, and rough.

In all the affected parts of the skin there exists a certain degree of numbness or anæsthesia. In the early stages of the disease there is scarcely any pain; nevertheless, if the ulnar nerve be pressed against the inner condyle, the pain is frequently acute, and the same occurs from pressure on the peroneal nerve. As a consequence of imperfect innervation, the fingers are frequently slender and benumbed; they are brown from pigmentation; and the metacarpal space between the forefinger and thumb is hollowed, from defective nutrition of the abductor muscle.

Varieties.—Starting with one uniform series of premonitory symptoms, leprosy after a while evinces a remarkable tendency to pursue an elective course. In the great majority of cases the prime seat of manifestation of the disease is the integument and mucous membrane; this constitutes the form of the disease known as *elephantiasis tuberosa*. In a smaller number of cases the affection of the nervous system, and particularly loss of sensation, are most conspicuous; and this constitutes the group called *elephantiasis anæsthetica*: whilst a sub-group of *elephantiasis anæsthetica* is remarkable for dislocation and amputation of the members at the joints; constituting *elephantiasis nodosa*, joint-evil, or *elephantiasis mutilans*.

In the tegumentary or tuberous group, the conspicuous symptom is the development and gradual growth of solid papules or tubercles in the skin. These originate in the centre of the hyperæmic spots already mentioned, and do not make their appearance until after the disease has existed for several months. At first they are reddish in colour; afterwards they differ little in tint from the surrounding skin. They range in size from two lines to half an inch in diameter; and are slightly convex at the summit, and hard to the touch. Their development follows the progressive exacerbations of the leprous fever; they grow while the febrile process continues, and become stationary when it abates; each exacerbation, however, adds to their bulk, and forces them on to maturity. Having reached the mature stage, they soften and break up; an ulcer is formed, which discharges for a while; and then the ulcer heals. A common seat of the tubercles is the region of the eyebrows, which they denude of hair; they also give a frowning aspect to the countenance, and when of large size add a leonine fierceness to the expression, which has suggested the term *elephantiasis leontina*. Similar phenomena to those already described manifest themselves in the fauces, the nasal cavities, and the larynx—at first hyperæmic maculæ, then tuberous prominences, and next ulceration, so that the symptoms in this region are usually severe. The voice is hoarse; the nasal passages are clogged; occasionally the septum ulcerates; and sometimes the nasal bones fall in. Tubercles likewise form along the edges of the eyelids; the conjunctiva is inflamed and thickened; the cornea becomes opaque; and sometimes the eyeball is destroyed. The lips are rendered protuberant by the tubercles, and ulcerate like the rest. The external ear is likewise enlarged and studded with tubercles, and the lobule of the pinna is remarkably elongated, suggesting, with the large tubercles on the forehead, the features of the typical satyr. Finally, the leprous congestion extends to the scalp; the hair falls off, as it does on the eyebrows; and the term *elephantiasis alopeciata* receives some corroboration. On the trunk of the body the ulcers are frequently of considerable extent; and occasionally the limbs have the appearance of being stripped of integument from the shoulders to the hands.

The ulceration of elephantiasis is not, however, restricted to the softening of tubercles; instead of, as in this instance, beginning from without, it starts in its most extensive forms from within. There is at first a general swelling of a part, such as the heel or the joint of a great-toe; a blister is raised on the skin covering the swelling; the cuticle is rubbed off; and an ulcer is quickly established. All this may occur without pain and almost without the knowledge of the patient. A large quantity of a glairy, colourless fluid is poured out by the ulcer; the sore is asthenic and sluggish; in the case of a joint the bone may be exposed, and very probably the end of a phalanx will be forced through the opening, to be followed in due time by the rest of the bone; then the ulcer contracts; the cavity closes up; and the integument heals. After a time a similar process commences in the great-toe of the opposite foot, or in the joint of a thumb, and runs the same course—either the extrusion of a bone or the healing up of an asthenic sore, after a continuance of several weeks or months. The joints of the phalanges of the feet and hands are similarly attacked from time to time, and a considerable amount of deformity of these members results. But it is worthy of note that while these morbid processes are all of them subject to the periodical canon of the disease, they alternate in their occurrence; and it is to be further noted that an excessive discharge from one of these ulcers has a derivative influence, and communicates a sense of relief to the whole system.

Elephantiasis anæsthetica differs from elephantiasis tuberosa in the more decided manifestation of disorder of the nervous system. There are the same premonitory symptoms, the same hyperæmic spots and blotches on the skin, the same pigmentary maculæ; but there is an absence of tubercles and ulceration, the numbness and anæsthesia are more decided, a general state of atrophy creeps through the system, and the sufferer is prostrated by exhaustion. Neuralgic pains, which are not wholly absent in elephantiasis tuberosa, are more obtrusive in elephantiasis anæsthetica. A sense of dulness and heat pervades the surface; and there are sensations of tingling and prickling, and of burning heat. Whilst the integument is insensible, there are deep-seated burning pains, sometimes of a bone or joint, and sometimes of the vertebral column. These pains are greatest at night; they prevent sleep, and give rise to restlessness and frightful dreams. Moreover, the skin, robbed of its sensation, is prone to vesication and excoriation, and the latter frequently ends in ulceration. The

anæsthesia is often so great that the contact of fire or of the severest caustics occasions no sensation.

Elephantiasis mutilans is more local in its characters than either of the preceding; it is wanting in the tegumentary manifestations of elephantiasis tuberosa, and although essentially anæsthetic in its nature, the anæsthesia is local, and affects chiefly the limbs. In this form of the disease loss of the bones of the hands and feet is a conspicuous symptom; and not unfrequently the limb is lopped off painlessly at the ankle or knee, or at the wrist or elbow. When the phalanges and metacarpal or metatarsal bones are alone attacked, the last phalanx, probably from its higher vascular organisation, is generally spared; this may be the case even when the bones of the wrist are eliminated; and the hand or foot in this case is crumpled up, resembling a confused bunch of tips of fingers or toes. Often the bones are ejected; in these cases the integument heals in the most complete manner, and it is in similar cases, where considerable reparative power is obviously present, that spontaneous cure is most likely to occur. In elephantiasis anæsthetica the nervous system is too deeply and seriously implicated to admit of spontaneous cure; and in elephantiasis tuberosa the tegumentary system, both cutaneous and mucous, is likewise too extensively damaged to render cure a rational expectancy.

Prognosis.—The prognosis of leprosy is essentially unfavourable. A disease which tends to the continuous degeneration of the skin and mucous membrane, with general dyscrasia of the entire organism; which is impelled onwards by a law of periodic progression; and which has no tendency to spontaneous resolution, must necessarily be fatal, the only question being one of duration. A very few instances are on record in which individuals afflicted with this disease have survived, and these principally from amongst the cases of elephantiasis mutilans; but such instances must be regarded as the rare exception, rather than the rule. The tuberous form of the disease is more rapid in its termination than the anæsthetic form; and the duration of life in both ranges from about ten to twenty years.

Treatment.—The treatment of leprosy resolves itself into, first, the employment of means intended to promote improvement in the general health; and, secondly, the adoption of such empirical remedies as have acquired a favourable reputation for the cure of the disease. In the first category we must place the removal of the patient from the locality wherein the disease has been engendered, and possibly to one where the disease is unknown. Next would follow a liberal and generous diet, such as animal food and beer; with active exercise. Thirdly, tonic and nutritive remedies, such as cod-liver oil, iron, quinine, strychnine, bitters, and phosphates, should be given. Nitric acid has been praised by one physician, and acetic acid in combination with carbolic acid by another. There can be no doubt that under a generous regimen the patient will improve in health and strength; the periodical exacerbations of fever will be less frequent, and hope will gleam in the mind, both of the physician and the patient; but cure, alas! is as distant as ever.

Specific alteratives have been exhausted with equal want of success. Iodine has failed. Danielssen and Boeck administered arsenic largely; and the perchloride of mercury has been extensively used by Beauperthuy. When these and other remedies are employed judiciously, in combination with a generous diet, moderate exercise, and thorough stimulation and inunction of the skin, the symptoms invariably improve for a time; but the disease as certainly falls back into chronic sluggishness and smouldering inactivity when they are relinquished or neglected.

The principal empirical remedies which have been recommended in this disease are:—the asclepias gigantea; hydrocotyle asiatica; veronica quinquefolia; chaoulmoogra oil, and gurjun balsam. The asclepias or rumex gigantea, the mudar of Hindostan, has received the name of vegetable mercury. The part of the plant employed medicinally is the root-bark, reduced to powder; and the dose of the latter is half a drachm daily. The hydrocotyle asiatica, in the form of powder of the dried plant, is given in doses ranging between one and six grains daily, and is also administered as an infusion, a syrup, and an extract; its active principle is vellarine. The medicinal part of the veronica quinquefolia is its root, and ten ounces of the root has been mentioned as a quantity sufficient to cure a leprosy. The chaoulmoogra oil is procured from the seed of an Indian tree, the chaoul moogra or gynocardia odorata. It is administered both internally and externally, the dose for the former purpose being six to twelve minims, three times a day. A tincture of the plumbago rosea has also been found serviceable in cases of anæsthetic leprosy; the dose being one drachm three times a day.

More recently Dr. Joseph Dougall has recommended gurjun balsam or wood oil as a very promising and successful remedy. It is an oleo-resin, obtained from one of the species of the dipterocarpus tree of India; and is given in the form of an emulsion, in combination with an equal proportion of lime-water, the dose of the emulsion ranging between two and four drachms twice a day. Or it may very conveniently be administered in capsules, each containing a drachm.

The local treatment of leprosy consists in stimulation of the skin by means of hot-air baths, followed by frictions and inunction with bland and stimulating oils. Ointments and liniments of the specific remedies already mentioned, namely, mudar, hydrocotyle, and gurjun, have been used for this purpose, as well as for dressing the ulcers. Danielssen and Boeck employed counter-irritants in the course of nerves presumed to be affected, with cupping and moxæ to the spine in anæsthetic leprosy; whilst they treated the tubercles of tubercular leprosy with the acid nitrate of mercury, and with a strong solution of potassa fusa. Beauperthuy found benefit result from the acrid irritating oil of the shell of the cashew nut (*Anacardium orientale*) used as a blister to the tuberous skin; a copious exudation followed the application, and relieved both the local and the constitutional symptoms. The gurjun treatment is accompanied by energetic frictions with a liniment composed of equal parts of the balsam and lime-water, the same as the emulsion

taken internally; and asthenic ulcers are pencilled with a solution of chloride of zinc.

A review of these various methods of treatment, and a consideration of the personal attention required by the patient suffering under this terrible disease, are suggestive of the observation that it can only be effectually treated in an institution devoted especially to the purpose.

ERASMUS WILSON.

LEPTOMENINGITIS (λεπτὸς, delicate or thin, and *meningitis*).—A term signifying inflammation of the pia mater. By its use, in association with arachnitis and pachymeningitis, we are enabled accurately to indicate the precise seat of inflammation involving the meninges of the brain or spinal cord. There is a practical convenience, warranted by pathological facts, in retaining the term arachnitis, although anatomists are not now disposed, as they were formerly, to believe in the existence of an arachnoid membrane, distinct, externally from the dura mater, and internally from the pia mater. *See* MENINGES, Diseases of.

LEPTOTHRIX (λεπτὸς, delicate or slender, and θρὶξ, a filament or hair).—*Leptothrix buccalis* is a name assigned by Robin to certain vegetable parasites or minute filaments, which can be recognised by means of the microscope, amongst the epithelial scales of the tongue or other parts of the mouth; and especially between the teeth, or in the hollows of decayed teeth. They occur in healthy persons, as well as in the sick, and have in this situation really no pathological signification. Organisms of the same kind are, however, now commonly named *bacilli*, and have during the last two or three years been recognised as exceedingly common in many organic solutions, and also within the blood and tissues of animals and of man suffering from splenic fever (*see* PUSTULE, MALIGNANT). Some regard them as constituting a distinct genus, whilst others believe them to be only one of the multitudinous forms that may be assumed by bacteria, when growing in certain kinds of media. *See* BACTERIA; and MICROCOCCI.

Dermatologists also employ the term leptothrix to indicate a morbid thinness and weakness of the hair.

LESION (*lædo*, I hurt.)—This word originally signified a hurt or an injury; but its use is now extended to comprehend all organic changes of a morbid character, affecting an organ or tissue.

LETHARGY (λήθη, oblivion, and ἀργία, idleness).—A disorder of consciousness, which consists of prolonged and profound sleep, from which the patient may be momentarily aroused, but into which he falls off again immediately. *See* CONSCIOUSNESS, Disorders of; and TRANCE.

LEUCE (λευκὸς, white).—This term has been applied to blotches in the skin of a white colour; and hence it has alternately been confounded with lepra alphoides, with vitiligo, and with the leucodermic blotches of leprosy. It seems, however, more than probable that the pathological condition intended to be signified by this word, is a circumscribed scleriasis, namely, that which we at present term *morphœa alba*. *See* MORPHŒA.

ERASMUS WILSON.

LEUCIN (λευκὸς, white).—Leucin, the chemical composition of which is $C^{12}H^{13}NO^4$, is a product of decomposition of albuminous bodies. It may be obtained from them by the action of caustic alkalies, or by long boiling with sulphuric acid. It is found in the secretion and substance of the pancreas, in the spleen, thymus, thyroid, suprarenal bodies, lymphatic glands, salivary glands, liver, kidneys, and brain. It is also found in old scales of the epidermis, and in ichthyosis, old toe-nails, and sebaceous cysts. Pathologically it occurs in abundance in the urine and liver of those who die of acute yellow atrophy; and, it is said, in the urine of those suffering from severe typhoid and variola, although there is no chemical proof of this. Leucin is thought by some physiologists to be a stage in the decomposition of albuminous matters into urea. Under the microscope it is seen as round balls, having some resemblance to drops of oil, sometimes hyaline, sometimes with radiating marks, sometimes with concentric rings. The test for leucin with the microscope is very untrustworthy taken alone. Nearly every urine can be made to give this evidence. If leucin is to be looked for, it must be separated by the following process. The urine is precipitated with acetate of lead, filtered, and the excess of lead removed from the filtrate with sulphuretted hydrogen. The filtrate must be next evaporated to dryness; the residue extracted with boiling alcohol and filtered; and the filtrate evaporated to a syrup. If leucin be present, it separates in the form of the crystals described above. Chemical tests must now be applied to the crystals. A small portion is evaporated to dryness in a platinum crucible with nitric acid; and if leucin be present, a colourless, almost invisible, residue is left, which becomes yellow or brown when warmed with a few drops of soda solution. Leucin is almost always found associated with tyrosin. *See* TYROSIN.

J. WICKHAM LEGG.

LEUCOCYTHÆMIA (λευκὸς, white, κύτος, a cell, and αἷμα, blood).—SYNON.: *Leukæmia* (Virchow); *Splenopathia leucocythæmia* (Huss); Fr. *Leucocythémie*; *Diathèse lymphogène à forme leucémique* (Jaccoud); Ger. *Leucocythämie*.

DEFINITION.—A chronic disease, in which there is a considerable and permanent increase in the number of the pale blood-corpuscles; usually associated with enlargement of the spleen, sometimes also with that of the lymphatic glands, and with disease of the medulla of bone.

The term leucocythæmia proposed by the late Dr. Hughes Bennett is a convenient and significant designation, the essential feature of the disease being the excessive proportion of leucocytes in the blood. The term *leukæmia*, proposed by Virchow, is less obviously accurate, since the blood (as Parkes urged) although appreciably paler than normal, is not white.

Excess of leucocytes in the blood, slight or transient, is known as leucocytosis, and is met with in many morbid states. Permanent excess, sometimes considerable, but rarely very great, also occurs, associated with a primary enlargement of the lymphatic glands—'lymphatic leucocythæmia.' These cases differ in many important respects from the cases of leucocythæmia asso-

ciated with primary enlargement of the spleen; so that it is most convenient to describe them in connection with lymphadenoma, and to consider here only cases of splenic leucocythæmia. *See* LYMPHADENOMA.

HISTORY.—Pallor of the blood, as if pus were mixed with it, was noted by Bichat in the beginning of this century; and the combination of this appearance with enlargement of the spleen, was observed by Velpeau in 1827. The dependence of this alteration in the blood on an excess of pale corpuscles was described by Donné in 1844, and interpreted by him as due to imperfect transformation of white into red corpuscles. In 1845, two cases of the disease were published together, the one by Dr. Craigie, the other by Dr. Hughes Bennett; and to the latter appears to belong the credit of recognising the salient features of the affection as a distinct malady. A month later, however, Virchow published another case, independently and admirably worked out. In all these cases the change in the blood was only recognised after death. It was first observed during life in 1846, by Dr. H. W. Fuller, and subsequently by Dr. Walshe. In Germany the first case was diagnosed during life, by Vogel, in 1848. Since then numerous cases and descriptions of the disease have been published, of which the more important are those of Virchow, Hughes Bennett, Vidal, Huss, Ehrlich, and Mosler.

ÆTIOLOGY.—In only a small proportion of cases of leucocythæmia can any causation be traced. Race, as such, seems to be without influence. Heredity has only been traced, as a history of splenic disease in ancestors or collaterals, in one or two isolated instances. The disease is twice as frequent in men as in women. It may occur at all ages. It is very rare under the age of ten, and the numbers gradually rise, taking both sexes, to the decade between thirty and forty, when nearly one-third of the total occur (46 out of 154 cases). After forty they fall in each decennial period. In females, however, the maximum is reached in the period between forty and fifty; and of eleven cases over sixty collected by the writer, only one was in a woman. Position in life appears to exercise no influence on the occurrence of the disease. Depressing influences, inanition, over-exertion, and especially depressing mental emotion, are antecedents which have been occasionally noted. Sexual processes, in women, appear to have a distinct influence. The disease has been seen to be most frequent, in them, during the climacteric decade, and practically to cease when the menstrual epoch is over. In some cases the disease has commenced during pregnancy; in a larger number it has succeeded parturition. Injury to the spleen seemed, in one or two recorded cases, to be the cause of the disease. Small-pox, typhoid fever, acute rheumatism, pneumonia, and syphilis, have been supposed to be causes of the affection, but the ætiological relation is doubtful. Of all antecedent conditions, intermittent fever is incomparably the most frequent. In one-fourth of the total number of cases (150) analysed by the writer, there was a history either of ague or of residence in an ague district. The interval between the malarial affections and the disease varied from a few months to thirty years. The fact that, in many cases, a long period elapses, and that the attacks of ague, in some instances, were trifling, makes it probable that, in the cases in which the patients had merely lived in an ague district, the malarial influence, which did not cause ague, led to morbid changes which eventuated in the leucocythæmia. One patient under the writer's care, a middle-aged woman, had lived in a malarial district only during the first few years of her life, but, shortly before her birth, her mother had suffered from an attack of ague.

ANATOMICAL CHARACTERS. — *Blood.* — The blood, as seen after death or during life, is paler than normal, and may even be greyish-red in colour. In extreme cases coagulation is imperfect; a grumous chocolate-brown mass results. After defibrination three layers form—red corpuscles, pale corpuscles, and liquor sanguinis. Under the microscope the pale corpuscles are seen to be in great excess: instead of two or three *per* field, as in the normal, there may be several hundreds. Enumeration (*see* HÆMACYTOMETER) shows that not only are the white corpuscles increased, but the red are lessened out of proportion to the increase in the white, so that the total number of corpuscles is always diminished. Instead of the normal 5,000,000 per cubic millimètre, there may be only 2,500,000 or even 1,150,000 (50 and 23 per cent. of the normal). The proportion between the white and red varies, being 1–20, 1–10, 1–5, 1–2, or 1–1; or the white may be the more numerous. The apparent is greater than the real excess of white, in consequence of the closer contact of the red. It was proposed by Magnus Huss to regard as leucocythæmia only those cases in which the proportion is greater than 1 to 20, and the rule has been largely followed; but it must be remembered that in commencing cases the proportion may be smaller than this. The greatest change hitherto recorded was a reduction of the red from 5,000,000 to 470,000 per cubic millimètre (9 per cent. of the normal), and an increase of the white to 680,000 per cubic millimètre instead of 15,000, the normal average. The pale corpuscles may be of normal size; but usually some are large; and often many are smaller than normal (the *globulins* of Donné), especially when the lymphatic glands are affected. Reagents bring into view one to four nuclei. Some of the corpuscles present obvious fatty degeneration. The red corpuscles are usually normal in appearance, sometimes unduly pale. Nucleated coloured corpuscles have been seen in a few cases, believed to be intermediate forms between the white and red corpuscles. The specific gravity of the blood is lessened from 1,055, the mean in health, to an average of 1,042; the change being due to an increased proportion of water, from 790 parts per 1,000 in health, to 840 in leucocythæmia. The fat and fibrin are increased, and the latter sometimes presents a peculiar granular appearance. The iron is lessened. Abnormal constituents have also been found in the blood, such as the albukalin of Reichardt, mucin, a substance analagous to glutin, hypoxanthin, lactic and formic acids. Minute octohedral crystals have been found in the blood and in many organs after death. about ·016 mm. in

length. Their nature is uncertain. Since they have been found only after death, it is conjectured that the substance of which they consist is held dissolved during life. They are not peculiar to this disease.

Organs.—The *spleen* is always enlarged, sometimes extremely. Its weight varies from twice to fifty times the normal—1 lb. to 18 lbs. The average of 72 cases analysed was about 6 lbs. The average length is nearly 12 inches. The enlargement is commonly uniform; the shape of the organ being preserved. The surface is smooth, but often presents traces of local peritonitis, in the form of yellowish opaque patches. It is frequently adherent to the diaphragm, omentum, abdominal wall, intestines, or liver. Its consistence is usually increased, rarely diminished. The cut surface is smooth, and yields comparatively little blood; it is brownish-red, or even brownish-yellow, marbled with paler lines, due to thickened trabeculæ. The Malpighian follicles are not usually conspicuous. In cases which begin with enlargement of the lymphatic glands, and which are really cases of primary lymphadenoma, the Malpighian follicles may be so enlarged as to constitute small growths. There is rarely an area of distinct softening. Wedge-shaped, yellowish-white, caseous portions are frequent, and are evidently infarcts; when recent they are deep red. The histological change in the organ is an overgrowth of the splenic pulp; the trabecular tissue is increased; and so also is the retiform tissue of nucleated fibres and cells, among which the lymphoid corpuscles lie. The Malpighian bodies may not be discoverable with the microscope, or they may be found to have undergone fatty or lardaceous degeneration. The infarct-like masses present the splenic tissue-elements in a state of fatty degeneration. In many cases the crystals, already described, have been found in the spleen in great abundance. This organ has been found by analysis to contain glutin, glycocoll, hypoxanthin, xanthin, leucin, and tyrosin.

The *lymphatic glands*, some or many, are enlarged in one-third of the cases of primarily splenic leucocythæmia (51 out of 157 cases). The order in which the several groups are affected is, beginning with the most frequent, the mesenteric, cervical, inguinal, axillary, retro-peritoneal, thoracic, portal, and iliac. In only five cases was the change universal. The enlargement is not considerable, the individual glands rarely attaining the size of a walnut. They are usually smooth, soft, grey, or reddish-white on section; rarely caseating or suppurating; sometimes presenting hæmorrhagic extravasations. Their minute structure differs little from the normal. Lymphoid corpuscles lie in an adenoid reticulum, which is rarely increased, as it is in lymphadenoma.

With respect to the *alimentary canal*, the gums are occasionally swollen and ulcerated, the swelling being due to infiltration of the gum with leucocytes, or to an actual lymphoid growth. The tonsils and follicles of the tongue are sometimes enlarged by lymphoid growth; and there may be a similar change, usually slight, in the lymphoid tissue of the wall of the stomach, and much more considerable in the solitary and agminated glands of the small intestine. These growths frequently ulcerate. Similar changes are also found in the large intestine. The *peritoneum* sometimes presents similar growths. The *liver* is enlarged in at least two-thirds of the cases, varying in weight from 5 lbs. to 14 lbs. In some cases of slight enlargement no structural change beyond congestion has been found; frequently, however, there are disseminated lymphoid growths, minute, greyish-white, commonly interlobular in position, often surrounding branches of the portal vein. The capillaries are always distended with pale corpuscles. Fatty degeneration of the liver-cells is also common. The *kidneys* are abnormal in at least one-half of the cases. They may be simply pale from anæmia; pale and enlarged, from granular degeneration of the cells, and distension of the capillaries with leucocytes; or they may present minute growths similar to those in the liver, and situated between the tubuli of the cortex, especially near the glomeruli. Marked fatty degeneration of the kidney has also been found. The *suprarenal bodies* have been found diseased in several cases, and in one or two there was bronzing of the skin. The *thymus* and *thyroid* glands have also been found enlarged. The *heart*, as in other cases of intense anæmia, may present granular and fatty degeneration. Extravasations of blood have been found beneath the endo- and pericardium. Its capillaries are often distended with leucocytes. Pericardial effusion is common. The *lungs* may present simply distension of capillaries, or hæmorrhagic infarcts, or actual growths, similar in structure to those found elsewhere. These commence at the bronchi and infiltrate adjacent tissues. Rarely they may break down and form cavities. Pleural effusion is very common, and lymphoid growths have been found on the membrane. In the *brain*, hæmorrhages, usually multiple, constitute the most frequent change. Minute growths in the membranes, distension of the meningeal vessels with pale blood, and their obstruction by masses of leucocytes (Bastian), have also been recorded. The *skin* is, in rare cases, the seat of growths. The *bones* have lately been found diseased in many cases (Ranvier, Neumann, &c.). The marrow is grey or reddish-grey, diffluent, and presents lymphoid cells and blood-corpuscles. Sometimes cells intermediate between white and red corpuscles have been found in it. The vessels are fewer than normal. The change may be found in all the bones, most marked in those which possess most spongy tissue, as the ribs and vertebræ, but also considerable in the long bones. Externally the bones may be normal or enlarged. The compact substance may be reduced in thickness, and even perforated (Mosler). The *retina* is frequently diseased. Hæmorrhages may be found, especially in the nerve-fibre layers, and adjacent to them the retinal elements may be degenerated. The capillary vessels are filled with pale corpuscles, and actual lymphoid growths have also been found.

Symptoms.—Of the early symptoms of leucocythæmia, the most frequent are those due to the splenic enlargement, namely, abdominal fulness, pain, or an actual tumour. Next in frequency is

weakness. Hæmorrhage, especially epistaxis, often occurs early, but rarely before other indications of ill-health. The change in the blood causes pallor of skin and mucous membranes, shortness of breath, and all the indications of anæmia. To its defect a large number of the symptoms to be described are due. The altered characters of the blood, readily observable during life, have been already described. The temperature is frequently, but not invariably, raised. It is commonly higher in the evening than in the morning; the evening rise usually reaching 101°–104°. The morning fall may be considerable or slight. Sometimes periods of considerable pyrexia alternate with others in which there is little fever. The cases in which there is most pyrexia are usually, but not always, those of most rapid course. The enlargement of the spleen presents the typical characters of a splenic tumour. It may occupy the whole left half of the abdomen, extend even beyond the middle line, descend into the iliac fossa, and even into the pelvis, so as to be perceptible by vaginal examination (Spencer Wells). It may vary in size from time to time. Friction may sometimes, and a *bruit de souffle* rarely, be heard over it. It usually causes an unpleasant sense of distension, is often tender, and sometimes is the seat of spontaneous pain. By its pressure it may raise the heart, cause considerable dyspnœa, and interfere greatly with the functions of the stomach. The distension of the abdominal wall may cause lines, similar to those of pregnancy, to appear over the spleen, and their position is sometimes distinctly determined by the course of vessels. The enlargement of the glands is rarely sufficient to give rise to other symptoms than the obtrusive evidence of their presence. The glands thus present, in this disease, a marked contrast to their condition in lymphadenoma. They often lessen in size before death. The alteration in the bones is usually unattended by symptoms. Rarely they become distinctly enlarged and tender. The action of the heart is disturbed by both the anæmia and the displacement. The pulse is frequent; and palpitation is common. The circulation is impeded; effusion of serum into the cellular tissue of the body is almost invariable in the later stages of the disease. Slight ascites is frequent, and great effusion is sometimes due to the pressure of enlarged glands on the portal vein. Hydrothorax is also common. The most striking circulatory symptom is hæmorrhage, which occurs in a large proportion of cases, most frequently from the nose, and less frequently from the bowels, stomach, lungs, uterus, into the skin, brain, joints, cellular tissue, or peritoneum. The hæmorrhagic tendency is so great that slight injuries may give rise to serious loss of blood; the extraction of a tooth, or the puncture for paracentesis, has thus led to death; while most cases in which excision of the spleen has been attempted have been fatal from the same cause. The respiration is usually interfered with, partly from the splenic enlargement, and partly from the anæmia; that due to the former is increased by the recumbent posture. The anæmic dyspnœa may be unnoticed when the patient is at rest, although any considerable movement causes an agony of breathlessness. The dyspnœa is also increased by changes in the lung, bronchial catarrh, and the frequent pleural effusion in the later stages. Cough is frequent, and may be an early symptom of the disease. The change in the gums, already described, may lead to ulceration—the 'leukæmic stomatitis' of Mosler; but it is more rare in this disease than in lymphadenoma. The gastric functions are chiefly interfered with by the pressure of the spleen, which causes dyspepsia, and often vomiting. Diarrhœa is extremely common, and may be accompanied by hæmorrhage. The enlargement of the liver may be recognised during life, but rarely gives rise to subjective symptoms. Jaundice only results from compression of the bile-ducts by enlarged glands. A yellowish tint of skin is, it may be remarked, frequent, apart from true jaundice—the 'icterus lienalis'; it probably results from the anæmia, the altered blood being unable to destroy the bile-pigment absorbed into it from the intestine. The urine varies in amount, but is usually strongly acid, and of high specific gravity. The amount of urea is unaltered, that of uric acid is increased. Hypoxanthin, lactic acid, and formic acid have been found in it. Albumin is rare, apart from structural changes in the kidneys. Menstruation is usually arrested. The functions of the nervous system are disturbed by the altered blood; languor, tinnitus, and vertigo are frequent; and slight mental failure, delirium, and coma are occasionally met with. The graver symptoms are probably due to capillary obstruction by masses of leucocytes, or to small hæmorrhages. Besides the noises in the ears, deafness is common, especially towards the end. In the fundus oculi, changes may usually be seen with the ophthalmoscope. The pallor of the blood in the retinal and choroidal vessels is conspicuous. The retinal veins become very broad, and are often tortuous. Extravasations of blood are almost invariable at some period, usually striated, sometimes rounded. Yellowish or white spots are sometimes seen, due to the collections of lymphoid cells already described. Occasionally the retina is irregularly thickened, so that the vessels present conspicuous antero-posterior curves. These changes constitute the 'leukæmic retinitis' of Liebreich. The extent to which sight is interfered with depends on the degree to which the neighbourhood of the macula lutea is involved. The skin is strikingly pale, or sometimes, as already stated, greenish yellow. Occasionally a peculiar dark pigmentation is present. Sweating is common.

Complications.—The most frequent complications of leucocythæmia are pleural effusion, œdema of the lungs, lobar pneumonia, bronchial catarrh, pericardial effusion, dilatation of the heart, venous thrombosis, cerebral hæmorrhage, and fatty degenerations; and the more rare are cirrhosis of the liver; parenchymatous degeneration of the kidneys, giving rise to the symptoms of subacute Bright's disease; renal calculi; persistent or intermittent erection of the penis, the former probably due to thrombosis in the corpora cavernosa; œdema of depending parts; ascites; furuncles; and erysipelas. The various hæmorrhages are rather to be regarded as symptoms of the disease than as complications.

Duration.—Cases of splenic leucocythæmia vary in duration from six months to seven years.

One or two recorded cases ran their course in less than six months. The average duration of sixty-three cases was two years. The actual duration of the affection is probably longer than this, because the disease has often reached a considerable degree before the symptoms became troublesome.

Causes of Death.—The most common causes of death in leucocythæmia are loss of blood, asthenia, diarrhœa, cerebral hæmorrhage, pneumonia, and pleurisy. In asthenia the actual end is often due to cardiac failure. The hæmorrhage most frequently fatal is from the nose, the next most frequent from the bowels.

Pathology.—The pathology of leucocythæmia is still involved in obscurity. We are imperfectly acquainted with the normal life-history of the blood-corpuscles. For a full discussion of the facts which have been ascertained, and the theories built upon them, the reader is referred to the writer's article on the disease in Reynolds' *System of Medicine*, Vol. v. It is only possible here to give a brief outline of the pathology of the disease which these facts and theories suggest. Recent researches make it probable that the red corpuscles arise from a transformation of the smaller lymphoid cells—*globulins* of Donné, hæmatoblasts of Hayem—and that this transformation takes place to a large extent in the splenic pulp and in the marrow of bones, tissues which have many histological characters in common. If these tissues are diseased, the transformation may not take place, and the unchanged lymphoid cells may develop into the ordinary leucocytes, which are either retained in these tissues, increasing their bulk and changing their structure still further, or pass into the blood. Both results probably occur. Hence we assume a primary change of the splenic pulp, which is increased further by the retained leucocytes. Where the hæmatoblasts arise, is still uncertain—they are probably in part developed in the splenic pulp and marrow of bones, from pre-existing cells, and from the protoplasmic trabeculæ of the tissues (Klein); probably in part they come from the true lymphatic structures, the glands, Malpighian follicles of the spleen, &c. Primary disease of these lymphatic structures constitutes lymphadenoma; and the splenic pulp may be normal, and the leucocytes are only in slight excess, or are not more numerous than they should be. In true splenic leucocythæmia the glands and Malpighian follicles are not primarily diseased, but they may suffer secondarily, when lymphatic growths arise in organs; and this secondary affection is in part the result of the accumulation of leucocytes. That the enlargement of the spleen is not, as has been thought, merely the result of the accumulation in it of pale corpuscles from primarily diseased blood, is shown by the increased consistence of the organ, and by the fact that the splenic tumour precedes the change in the blood. There is some reason to believe, that as the spleen alone may be diseased, so, in some rare cases, the marrow of bones may alone be diseased, and may give rise to a primary 'myelogenic leucocythæmia,' but this is not yet proved. That the disease may be primary in both the marrow and the spleen, is highly probable from recorded facts. It is certain, however, that the marrow is, in most cases, not affected primarily, and may be unaffected throughout, or may suffer secondarily, as do the glands. The same is true of the collections of lymphatic tissue elsewhere in the body. The cases in which the lymphatic glands enlarge early—'lymphatico-splenic leucocythæmia'—are, for the most part, if not entirely, cases of composite nature. The spleen presents a double change—growths in the follicles, such as are associated with the glandular growths in lymphadenoma (Hodgkins' disease), and increase in the splenic pulp, as in pure splenic leucocythæmia. In such cases there may be a large increase in the pale corpuscles of the blood.

Diagnosis.—The diagnosis of leucocythæmia rests on the existence of enlargement of the spleen, and a considerable excess of leucocytes in the blood. In all cases of splenic tumour, the blood should be examined; if the proportion of white corpuscles to the red is greater than 1 to 20, the case is certainly one of leucocythæmia. But if the proportion is less than this, leucocythæmia cannot with certainty be excluded, because it is probable that, in all cases, the splenic tumour and anæmia precede the leucocytal excess, and the latter may be in process of development. To ascertain the actual state of the blood, it is always desirable to enumerate the corpuscles with the hæmacytometer. Repeated examination, to ascertain that the proportion of pale corpuscles is not increasing, is necessary before impending leucocythæmia can be excluded. In cases in which the lymphatic glands enlarge early, the question arises whether the case is one of splenic leucocythæmia, or of Hodgkins' disease. In the latter, as just stated, the enlargement of the spleen depends, not on an increase of the splenic pulp, but on overgrowth of the Malpighian follicles; the splenic enlargement is less than in leucocythæmia, and is less uniform. In the composite cases alluded to above, in which, with enlargement of the glands and splenic follicles (lymphadenoma), there exists also overgrowth of the splenic pulp, and a considerable leucocytal excess in the blood, the two morbid processes are conjoined, and the affection may be termed lymphadeno-splenic leucocythæmia. These cases are distinguished from the simple splenic affection by the early enlargement and firmness of the glands. In simple splenic leucocythæmia the affection of the glands is usually late, and rarely considerable. The diagnosis of the disease from conditions in which a considerable excess of pale corpuscles exists, without enlargement of the spleen, is usually easy, because such excess is transient, soon passes away, and is not associated with a splenic tumour.

Prognosis.—The prognosis of a disease which depends on a primary affection of the blood-forming organs is necessarily most grave. No means of arresting the progress of the developed disease has yet been discovered. The immediate prognosis is less serious in proportion as the evidence of organic changes in the blood-forming organs is slight, and in proportion to the early stage of the disease. Neither age, sex, nor causation affords prognostic information. The greater the number of white corpuscles and the deficiency of red, as ascertained by counting, the worse the

prognosis. The size of the spleen, alone, affords little information. Hemorrhages are of grave augury, but epistaxis least so.

Treatment.—The knowledge of the causes of leucocythæmia, slight though it is, suggests important prophylactic measures—the prevention of ague, and the careful treatment of all who have been exposed to malarial influences. Splenic tumours resulting from such exposure should be systematically treated; the subjects of them should exercise great care to avoid exposure to cold, injuries, and all causes of portal congestion. These precautions are especially necessary in women at the menstrual periods; and if such women bear children, their state during pregnancy and after parturition should be carefully supervised, and lactation prohibited. Whether there is simple anæmia or leucocythæmia, every effort should be made to reduce the size of the splenic tumour, by quinine, cold affusion, ergotine, and especially by voltaic electricity, a most powerful agent. By obtaining contraction of the spleen, expelling retained leucocytes, and perhaps stimulating directly its functional action, we render its condition less abnormal. In a case of anæmia splenica no remedies improved the blood-state till the spleen was galvanised, when the red corpuscles at once began to increase. Remedies which do good in ordinary anæmia have slight influence in this disease. Iron is almost useless; cod-liver oil, however, has seemed to do some good. Arsenic has been largely tried, but without benefit in pronounced cases. Its undoubted value in lymphadenoma suggests its further trial in early cases; it should be given in the largest doses that can be borne. Phosphorus has been recommended, but in almost every case of pronounced leucocythæmia it has been powerless for good. Nevertheless, its influence in improving the blood-state in lymphadenoma warrants further trial in the early stage of the disease. Iodides, bromides, and mercury are useless. Change of air may slightly improve the patient's state, but has no influence on the disease. Transfusion has been tried, but the results are not encouraging. Excision of the spleen has been suggested. The operation has been performed with success in cases of anæmia splenica, but in actual leucocythæmia the operation has been invariably fatal—in most cases from uncontrollable loss of blood, the result of the hæmorrhagic tendency. Further trial of it, in such cases, is not justifiable. In early cases, where there is no considerable excess of pale corpuscles, and the red are not reduced below sixty per cent. of the normal, it might be successful; but it is questionable whether, in such cases, the ultimate issue without interference is sufficiently certain to justify the performance of so grave an operation. Special symptoms may require treatment. Hæmorrhage must be checked by the usual methods, and crystals of perchloride of iron may be applied to accessible places (Jenner). For vomiting, a posture which will relieve the stomach from pressure, and counter-irritation, are useful. Aperients should be employed with caution; and under no circumstances should the yellow tint of the skin lead to the use of mercurials. For the œdema, digitalis and other diuretics are best. For the splenic pain, counter-irritation, sedative liniments, and hypodermic injections of morphia may be used. In proportion to the anæmia, physical rest is important, that the diminished supply of oxygen may not be rendered inadequate for the need of the tissues, by muscular exertion. W. R. Gowers.

LEUCOCYTOSIS (λευκὸς, white, and κύτος, a cell).—A condition of the blood, in which the white corpuscles are appreciably but moderately increased. *See* Blood, Morbid Conditions of.

LEUCODERMA (λευκὸς, white, and δέρμα, the skin).—White or achromatous integument. *See* Pigmentary Skin-Diseases.

LEUCOMA (λευκὸς, white).—A white opacity of the cornea, generally referable to inflammation or ulceration of that structure. *See* Eye and its Appendages, Diseases of.

LEUCOPATHIA (λευκὸς, white, and πάθος, a disease).—Synon.: Albinism, Achroma, Leucoderma, Leuce, Leucasmus.

This disease is sometimes general, but frequently partial; in the latter form constituting *cutis variegata* and 'piebald skin.' The whiteness is referable to absence of pigment, which may be simply due to an arrest of function of the rete mucosum, or to an organic alteration of the integument. *See* Pigmentary Skin-Diseases.

LEUCO-PHLEGMATIC TEMPERAMENT. *See* Temperament.

LEUCORRHŒA (λευκὸς, white, and ῥέω, I flow).—Synon.: Fr. *Leucorrhée*; Ger. *Weisser Fluss*; Lat. *Fluor Albus*; Pop. 'The Whites'; 'White Discharge.'

Definition.—A non-hæmorrhagic discharge, of pale colour, escaping from the female genital fissure.

Ætiology.—Leucorrhœa is a symptom rather than a distinct disease; and is found resulting from all the morbid processes that lead to hyper-secretion from the genital mucous surfaces, or from the glands opening upon them, whether the mucous membranes be injured or entire. It is, however, a source of much discomfort and deterioration of health, and so demands special treatment.

Symptoms.—Leucorrhœa presents several distinct varieties according to the seat of its cause; and the symptoms of each variety require separate consideration.

1. **Vulvar Leucorrhœa.**—In this variety a glairy viscid secretion is found bathing the apposed surfaces of the pudenda, stiffening into a crust on the surface of the labia majora or on the insides of the thighs, and sometimes glueing the lips more or less firmly together at their margins. It is usually derived from the muciparous glands covering the internal surfaces of the labia majora and the nymphæ; but in cases of special eruptions and general vulvitis it may come from the vestibular surface; and in still rarer cases it is poured out from the glands of Bartholin. Vulvar leucorrhœa is met with at any period of life, but is most common in the young, *infantile leucorrhœa* almost always being of this variety. In cases of gonorrhœal infection

in the female, the vulva is usually the seat of a profuse discharge that is apt to become purulent, but it is rarely confined to this situation, spreading both into the urethra, and upwards into the higher spheres of the genital mucosa.

2. **Vaginal Leucorrhœa.**—The discharge in cases of vaginal leucorrhœa is most frequently white in appearance, of acid reaction, and due to a secretion from the general surface of the vaginal mucous membrane. Its whiteness, on microscopic examination, is found to be owing to the presence of quantities of scaly epithelial cells, many of which are crowded with fatty particles, whilst others have been quite dissolved in consequence of the fatty degeneration. Sometimes the discharge has a more yellowish tint, and then it is found to contain quantities of pus-cells among the epithelial scales. In the former group of cases we have to do with a simple catarrhal condition of the vaginal mucosa; in the latter there are red granulation-like spots scattered over the membrane, which has here lost its epithelial covering. Vaginal leucorrhœa is a complaint to which women are specially liable during their reproductive life. The catarrhal form is extremely common in young married females; whilst the other form occurs rather about the ménopause, or, if occurring earlier, is complicated with some of the other varieties of leucorrhœa. Apart from specific causes, it may be brought on by sexual excesses; by the presence of a foreign body, such as a pessary; by a displaced uterus; by a chill; or by any condition that interferes with the circulation in the pelvis. In a large proportion of cases it is secondary to the next variety of leucorrhœa.

3. **Cervical Leucorrhœa.**—The discharge that comes from the canal of the cervix uteri is transparent, like unboiled white of egg, very tenacious, and of alkaline reaction. It may still present these characters as it escapes from the pudenda; but it generally becomes somewhat clouded as it passes through the vaginal canal, and gets acted upon by the acid secretion from the vaginal walls. Independently of this change in the vagina, it is sometimes found already more or less opaque as it lies within the cervical canal, and may be seen of a yellowish or greenish or reddish tint in various cases. The clear cervical leucorrhœa is seen under the microscope to be made up of a viscid magma, having entangled in it large numbers of columnar epithelial cells, which have a tendency to arrange themselves in rows. These are easily seen to be the ciliated epithelial cells that cover the normal mucous membrane, but deprived for the most part of their cilia. They are accompanied by smaller rounded cells like mucous corpuscles or wandering cells, partly derived from the interior of the crypts, and partly shed from the general surface from which the epithelium has been removed. In almost all cases some of the epithelial cells and mucous corpuscles are charged with fatty particles, and surrounded with granules, resulting from the breaking down of some of their number. The more turbid the fluid, the more the cells are found to have undergone such degeneration; and where the discharge is profuse, fluid, and of yellowish colour, it has more the characters of a purulent fluid in which the relatively few cylindrical cells are changed in form, becoming oval or rounded, and nearly all reduced to a compound granular mass. The more deeply tinted discharges owe their discoloration to the admixture of blood, the red corpuscles of which can easily be recognised. Apart from the leucorrhœas of specific origin, this is the commonest of all the varieties. It may be found in females of any age, but specially affects women during their reproductive history, and more especially those who have been mothers. We can understand the special liability of the cervix to catarrhal affections, when we remember that all intra-uterine discharges pass through and may irritate it; that it is exposed to damage during the transit of the fœtus in parturition; that vaginal affections easily pass into it by continuity of structure; and that it may readily be injured by foreign bodies in the vaginal canal, or even by fretting of its orifice against the vaginal wall in cases of displacement or excessive mobility.

4. **Intra-uterine Leucorrhœa.**—Here also the discharge is transparent, like white of egg, and alkaline in its reaction, but it is more fluid than the secretion from the cervical canal, and may escape as a clear liquid from the genital fissure. In cases of long standing, more particularly where there exists some organic disease in the uterine parietes, the fluid becomes turbid, purulent, and more frequently than in any other variety of leucorrhœa tinged with blood, even alternating with irregular discharges of blood. Under the microscope we see many cylindrical epithelial cells, not infrequently ciliated; along with groups of smaller cells, partly cylindrical, partly rounded, that have been discharged from the uterine follicles; all imbedded in a mucous fluid. Where the discharge is more turbid, the epithelial cells are seen to be undergoing fatty degeneration, and to be accompanied with wandering cells, pus-globules, and crowds of free fatty particles. This uterine leucorrhœa may be found at any period of life, but as an independent affection it is found almost exclusively in virgins or young married women, or in women who are ceasing, or have ceased, to menstruate. In the last-named class of cases the cervix is often atrophied, and its orifices narrowed; and the intra-uterine secretion may accumulate for a time, and be expelled with some degree of suffering. Most frequently it is found associated with cervical leucorrhœa, the endo-cervical affection having passed up to the endometrium, or, more rarely, *vice versâ*. Perhaps the most frequent form of it is found in women who are subject to a leucorrhœal discharge before or after the menstrual periods; and in the cases of amenorrhea where a pale discharge escapes at the usual menstrual periods, this has its source in the interior of the uterus proper.

5. **Tubal Leucorrhœa.**— Doubtless some small portion of the fluid that escapes in certain cases of leucorrhœa is furnished by the Fallopian tubes, but despite the elaborate attempts of Hennig and others to establish a distinction between it and the other varieties, it remains rather as a subject of pathological interest than of clinical importance, and need not occupy us further here.

Diagnosis.—The statements of a patient in regard to a leucorrhœal discharge cannot be re-

lied on in establishing a diagnosis as to its source. If it be white and flaky we may judge that it is vaginal; if more transparent, and escaping in half-coagulated flocculi, we may conclude that it is cervical; whilst a clear and more continuous and fluid discharge would be more justly referred to the uterus proper. But it is never safe to trust merely to the appearance of the discharge as it escapes from the vulva, for it may have become modified as it lay in or traversed some part of the canal, or may be compounded of fluids derived from different surfaces. The seat of the discharge must therefore be exposed. In the vulvar variety it suffices to separate the labia and occasionally to expose the navicular fossa and the orifices of the Bartholinian ducts, by passing the finger into the anus. The vaginal form of leucorrhœa requires for its detection the use of a speculum, duck-bill or tubular; and the cervical, one of these or a bi-valve speculum. For the diagnosis of intra-uterine leucorrhœa it is sometimes helpful to remove some of the fluid for microscopic examination by means of a fine syringe. Unless a clear history of infection can be obtained, it is almost impossible to establish a distinction between a gonorrheal discharge and the simpler catarrhal leucorrhœa. In the former there is a very notable tendency to spread through all the contiguous mucous surfaces, though the vulva may be predominantly affected. In children suffering from the infectious discharge, traces of the injuries that are usually inflicted at the period of infection should be sought for.

Treatment.—In instituting our treatment of leucorrhœa it is of the first importance to have in view the *constitutional* condition of the patient; to use means to counteract any diathetic tendency — tuberculous, strumous, or syphilitic; and to raise as far as possible the general standard of the patient's health, by the administration of tonics, and the enforcement of a suitable diet and regimen. It is partly in this way that a change of residence is often useful; and in making a change, it is well for the patient to go to some of the spas, such as Ems or Kissingen, the waters of which are helpful in reducing congestions and catarrhs of the pelvic viscera. In young women of relaxed habit of body, it may be enough to prescribe quinine and iron or arsenic, and the daily use of a cold sponge bath; and in infantile leucorrhœa, cod-liver oil and iodide of iron should be administered.

In the great majority of cases of leucorrhœa, some kind of *local* treatment becomes an absolute necessity. Sometimes it is enough to pay strict attention to cleanliness, washing the pudendal surfaces with a soft sponge, or syringing the vaginal canal with tepid water; and even when astringent applications are to be made, the surfaces should first be subjected to a detergent stream of water. Where there is marked congestion of the uterus it is best to make the injections with hot water, and to keep the stream passing through the vagina for at least five minutes at a time; the immediate relaxation of the blood-vessels and hyperæmia being followed by contraction of their walls, which favours the cessation of the discharge. The astringents most serviceable for checking *vulvar* and *vaginal* leucorrhœas are alum, aluminated iron, acetate of lead, sulphate of copper, sulphate of zinc, borax, and infusions of oak-bark, matico, and other vegetables charged with tannin. They are best applied in the form of an injection with a Higginson's syringe, having a vaginal nozzle attached to it; or of a douche through a long india-rubber tube, with a stop-cock for regulating the flow fitted close to the vaginal nozzle, and the other extremity opening into a wide receptacle, or fitted to a filler into which the fluid is poured. Where there is a difficulty in using the injection, and where it is desirable to keep up a more prolonged application of the medicament, it may be introduced into the vagina in the form of pessaries made with cacao-butter or with gelatine. Topical applications to the canal of the cervix and cavity of the uterus ought always to be made through the speculum, and without such applications it is a hopeless task to undertake the cure of *cervical* leucorrhœa. Here, more concentrated or more powerful astringents or escharotics become necessary. Nitrate of silver in the form of a stick of caustic is easily applied, but its repeated application may lead to mischief. Zinc-alum, dried sulphate of zinc, sulphate of copper, perchloride of iron, or tannin may be introduced in the form of rods or arrows made with starch and gum. If a uterine sound or stilette be dipped in water and a thin film of cotton wadding wrapped round the point to the length of about two inches, the adherent mucus can be cleared away, and the same or another sound mounted with wadding can be charged with fuming nitric acid, or the acid nitrate of mercury, or strong carbolic acid, or a solution of perchloride of iron, or tincture of iodine, and carried through the speculum along the cervical canal. In *intra-uterine* leucorrhœa it becomes necessary to carry the application right up in the same way to the interior of the uterus. It is usually best to begin with one of the stronger liquids, apply it a few days after a menstrual period, and follow it up with applications of iodine. So long as the stilette or sound with the dry wadding passes easily through the os internum, it is usually necessary to continue from time to time the intra-uterine application.

Alexander Russell Simpson.

LEUKÆMIA. *See* Leucocythæmia.

LEUTERBAD (Locite), **in Switzerland.** Thermal earthy waters. *See* Mineral Waters.

LICE, Diseases due to. *See* Pediculus.

LICHEN (λειχήν, an eruption).—This term was originally assigned to lichens of the vegetable kingdom from the idea, which is by them suggested, of adhesion to the bark of a tree. Subsequently the term became transferred to a diseased state of the skin, but the precise nature of that disease is unknown at the present day. The affection which most nearly realises the signification of the term is lepra vulgaris, or possibly a centrifugal cluster of papulæ. In the latter sense the term was adopted by Willan, and since his time it has been generally accepted as the type of a papular eruption of the skin. With this acceptation lichen is a follicülitis attended with prominence in the form of a minute pimple; and may be associated with eczema—as in the

instance of lichen simplex, lichen circumscriptus, lichen agrius, and lichen tropicus; or with urticaria—as in lichen urticatus. It may, however, be independent of these, as in lichen pilaris, lichen planus, and the eruption described by Hebra, under the name of lichen scrofulosorum. *See* APPENDIX. ERASMUS WILSON.

LIENTERIC (λεῖος, smooth, and ἔντερον, the intestine).—A form of diarrhœa in which the stools contain much undigested food, in consequence of its having passed rapidly along the alimentary canal. *See* DIARRHŒA; and STOOLS.

LIGHTNING, Effects of.— The effects produced by lightning differ only in degree from those produced by the discharge of static electricity, generated in the laboratory. With a Leyden jar of sufficient size a small animal may be killed, and in larger animals the effects of shock and local injury may be produced. By lightning a person may be killed outright, and a post-mortem examination may reveal no lesion whatever. The mode of death in these cases seems to be by the shock to the brain and nervous system generally. Effects not distinguishable from ordinary concussion of the brain may be observed, and the person struck may remain insensible, with slow respiration, scarcely perceptible pulse, and dilated pupils, for periods varying from a few minutes to more than an hour. This may be followed by complete recovery; or there may remain paralysis of the limbs, usually the lower, or occasionally derangements of the special senses—blindness, a metallic taste in the mouth, noises in the ears, and an odour in the nose. The brain may be more or less permanently affected, and we read of delirium, mania, and loss of memory as results of the lightning-stroke. Various objective phenomena have also been observed. The electricity on its way through the body may produce a number of mechanical effects. Wounds like those produced by a blunt stabbing instrument may mark the points of entry and of exit; bones have even been broken, the membrana tympani has been ruptured, and internal viscera have suffered in a similar way. Patches of erythema, urticaria, superficial ecchymoses, and scorchings of the surface having a curious tree-like and branched arrangement, have all been described; and this last phenomenon has apparently given rise to the assertion that delineations of trees standing in the neighbourhood of the accident have been traced photographically on the body of the victim. Lightning is apt to be attracted by any metal worn about the body. Watch-chains are frequently broken and fused, and by the intense heating of these metallic conductors the clothing has been set on fire. Watches have been broken and partially fused, and have forcibly burst through the pockets in which they were contained. Steel articles, such as pocket-knives, have been rendered magnetic. The clothing is sometimes burnt and torn to a great extent, and strong boots have been found burst open, or thrown off the feet to a distance, or nails in the soles have been driven out of them. The remote effects of lightning are due to the mechanical injuries produced by it: permanent paralyses may result from injury to the nerves, and inflammatory action may be set up by the injury inflicted on internal or external parts. One case is recorded in which the whole of the hair on the head and body, as well as the nails of both hands, came off after a lightning stroke. It has been asserted that *rigor mortis* does not occur in persons killed by lightning, and that the blood remains fluid for a very long time after death, but neither of these facts has been substantiated.

TREATMENT.—The treatment of those who have been struck by lightning consists in first rousing and keeping up the respiration and circulation. The cold douche is often of great value, and this combined with friction of the limbs, warmth to the extremities, and the administration of stimulants, either by the mouth or in the form of enemata, would seem to be the measures best calculated to restore the suspended animation. Secondly, special injuries must be subsequently treated according to their nature.

G. V. POORE.

LINEÆ ATROPHICÆ (Lat. Atrophic lines).—A form of scleroderma. *See* SCLERODERMA.

LIPOMA (λίπος, fat).— A fatty tumour *See* TUMOURS.

LIPPSPRINGE, in Germany.— Earthy waters. *See* MINERAL WATERS.

LISBON, West Coast of Portugal. — Warm, moist climate, with very variable temperature. Mean temperature in winter, 54° Fahr. Prevailing winds, N.E.–S.E. in spring; S.W. rainy. *See* CLIMATE, Treatment of Disease by.

LISDOONVARNA, in Ireland.—Sulphur waters. *See* MINERAL WATERS.

LITHIASIS. LITHIC ACID DIATHESIS (λίθος, a stone). *See* GOUT; and URIC ACID CALCULUS and DIATHESIS.

LITHONTRIPTICS (λίθος, a stone, and τρίψις, friction).—SYNON.: Fr. *Lithontriptiques*; Ger. *Steinauflösende Mittel.*

DEFINITION.—Lithontriptics are therapeutical measures used for the purpose of dissolving calculi in the urinary tract.

ENUMERATION.—The chief lithontriptics are: Water, Potash, Lithia, Borax, Phosphate of Soda, Soap, Lime-water, Nitric Acid, Phosphoric Acid, Hydrochloric Acid, Sulphuric Acid, and Mineral Waters, such as those of Wildungen.

ACTION. — Lithontriptics dissolve stone in various ways. Some of them possess a simple solvent action, as in the case of water. Others unite with the calculi so as to form a more soluble compound, as in the case of the union of potash or lithia with the uric acid of a calculus, producing urate of potash or lithia, which is more soluble than uric acid itself. In the case of phosphatic calculi dilute nitric acid combines with the bases of which they are composed to form a more soluble compound.

USES.—Lithontriptics may be employed for the purpose of dissolving calculi either in the kidney or in the bladder. They may either be taken internally, so as to act upon the calculi through the medium of the urine; or be injected directly into the bladder. This latter treatment can only be adopted in the case of a vesical cal-

culus, and is inapplicable in the case of a renal calculus. The most useful of all lithontriptics is water, and especially distilled water. When this is taken in large quantities, the urine becomes very dilute, and small calculi may be partially dissolved, so as to be reduced in size and ejected through the natural passages. If the calculus is composed of uric acid, potash or lithia is the best remedy for internal administration, the urates of these bases being more soluble than the urate of soda. In the case of phosphatic calculi, acid remedies are employed instead of alkaline; but it is exceedingly difficult to render the urine acid by means of acids given by the mouth, unless they are administered in quantities likely to derange the digestion. In place of mineral acids, benzoic acid and benzoate of ammonia have been employed, as benzoic acid passes out of the body in the form of hippuric acid, giving an acid reaction to the urine. On account of this difficulty, acids have been directly injected into the bladder, in order to act directly upon the stone; for which purpose nitric acid, largely diluted, is the one which has been most generally employed. This procedure, however, is now rarely had recourse to, as it is much easier to crush the stone by mechanical means.

T. Lauder Brunton.

LITHURIA (λίθος, a stone, and οὖρον, the urine).—A condition in which a deposit of uric acid or urates takes place in the urine. *See* Uric Acid Calculus and Diathesis; and Urine, Morbid Conditions of.

LIVER, Diseases of.—Synon.: Fr. *Maladies du Foie*; Ger. *Krankheiten der Leber.*

The liver is an organ which has always occupied a prominent place, both with the profession and the public, as being the seat of important diseases, as well as the origin and source of numerous symptoms and ailments. Not only is it concerned in the formation of one of the principal secretions, namely, the bile, but, according to most physiologists, it has a peculiar *glycogenic* function; and some authorities now maintain that it is in this organ that urea is formed. Moreover, a large quantity of blood passes through it, in connection with the portal circulation, by means of which the blood returning from the stomach, intestines, pancreas, and spleen is distributed throughout the liver, and thence conveyed to the inferior vena cava. Hence, hepatic affections, by interfering more or less with the physiological functions or anatomical arrangements of the organ, may give rise to diverse phenomena, not only of a local character, but associated also with the general system.

Summary of Diseases.—The individual affections of the liver will be treated of separately, in alphabetical order, but it may be well to indicate here beforehand their general nature. The first great division is that into *functional* and *organic*. *Functional* hepatic disorders are regarded by many eminent physicians as being of peculiar significance, and as demanding special attention, particularly with reference to those disorders which influence the secretion of the bile. The main *organic* diseases of the liver, in which there is some more or less obvious anatomical change, may be summarised thus:—1. *Congestion*, either active or mechanical. 2. *Hæmorrhage* into the organ, or so-called *apoplexy*. 3. *Acute inflammation*, usually terminating in *abscess*, rarely in actual *gangrene*. 4. *Chronic inflammation*, ending in the condition termed *cirrhosis*, in which the liver is hardened, granular, and usually contracted. 5. *Hypertrophy*. 6. *Atrophy*, either *acute*—which is a very fatal disease; or *chronic*, the latter being of different kinds. 7. *Biliary accumulation*. 8. *Malpositions* and *malformations*. 9. *Infiltrations*, including *fatty* and *albuminoid* disease. 10. *New growths*, especially hydatids, syphilitic formations, and cancer. Tubercle is occasionally found in the liver.

Ætiology and Pathology.—Taking a general survey of the causes which originate hepatic diseases, and of the circumstances under which they arise, the most important may be indicated thus:—1. An affection of the liver may be merely a local manifestation of some constitutional or general malady, as in the case of cancer, tubercle, syphilis, or albuminoid disease. The last-mentioned is remotely due to causes which need not be discussed here; but it may be mentioned that the liver is an organ very liable to suffer from albuminoid change. 2. Some local injury or irritation may originate hepatic disease, either from without, as a blow or stab; or from within, as sometimes happens in the case of biliary calculi. 3. Certain animal parasites entering the body are prone to lodge in the liver. This applies especially to hydatids, originating from the *Tænia echinococcus*. 4. From the intimate connection of the liver with the alimentary canal, and the existence of the portal circulation, hepatic disorders are very liable to arise from improper diet, as well as from digestive derangements in the stomach and bowels, and constipation. 5. Abuse of alcohol, and especially indulgence in ardent spirits, occupies an important position in the ætiology of disorders and certain diseases of the liver. Undue use of hot condiments is also regarded as an element of some consequence. 6. Long-continued exposure to a high temperature in tropical climates is a powerful cause of hepatic derangement and disease, particularly if accompanied with too free indulgence in alcoholic stimulants. 7. Diseases of the liver may arise by extension from neighbouring structures; or by the convection of morbid materials from more or less distant parts. The latter may be best illustrated by pyæmia; and secondary affections of this kind are believed to be particularly frequent in the liver, when the morbid products are conveyed directly from the alimentary tube, in consequence of some disease of its walls, such as ulceration. 8. Obstruction to the circulation, due to certain forms of cardiac disease, is an important cause of some hepatic affections. 9. Disorders of the liver are often attributed to various hygienic errors, exposure to cold, and other causes, but how far this conclusion is justified in particular cases is a matter of question.

Clinical Signs.—So far as the actual diseases of the liver are concerned, it is unnecessary here to regard any symptoms resulting from disturbance of the glycogenic functions, as these belong to a different category. The clinical phenomena to

be looked for lie within a limited range, and may be grouped under the following heads:—1. *Morbid sensations*, referred to the hepatic region, or to the shoulder, such as pain of various kinds, tenderness, sense of weight, throbbing. 2. *Symptoms due to interference with the biliary functions*, particularly jaundice and its accompanying phenomena. 3. *Symptoms resulting from more or less obstruction to the portal circulation.* These include digestive disorders, due to congestion or catarrh of the mucous membrane lining the stomach and intestines; hæmorrhage from this membrane in some cases; ascites, which is a most important symptom; enlargement of the spleen; congestion of the womb in women; hæmorrhoids; and, in certain conditions, dilatation of the veins of the abdominal wall. 4. *Symptoms produced by the pressure, or interference with neighbouring structures, of an enlarged liver.* Thus, it not uncommonly extends upwards, checking the movements of the diaphragm, and pressing upon the lung, hence causing dyspnœa. Or it may compress vessels and other structures; or in some cases it even interferes with the heart's movement. 5. *Physical signs.*—These indicate enlargement or contraction of the liver; changes in situation or shape; or changes in physical characters. 6. *General symptoms.* These may be more or less independent of the hepatic disease, this being merely a part of a general malady; or the liver-affection may give rise to pyrexia, wasting, and other symptoms. Hepatic derangements are supposed to originate many general symptoms, not obviously connected with this organ; and they have even been made accountable for the gouty state.

The individual diseases of the liver will now be discussed in alphabetical order.

FREDERICK T. ROBERTS.

LIVER, Abscess of.—SYNON.: Hepatic abscess; Fr. *Abcès du Foie*; Ger. *Leberabscess.*

Though of such importance as to require a separate notice, abscess of the liver is not an independent affection, but is only the consequence of inflammatory action set up in that organ.

ÆTIOLOGY.—As abscess of the liver is comparatively rare in temperate climates and frequent among Europeans in tropical ones, it has naturally been attributed to the effects of heat, or of alternations of heat and cold. Being occasionally associated with malarious fever, and frequently with dysentery, it is supposed that it may be induced by the same causes as those diseases. The opinion has been often advanced that abscess of the liver is always secondary to dysentery, or to ulceration of the bowels. That it may occasionally be so it would be difficult to deny, with reference to what is known of its occasional causal connection with operations on the rectum. But although dysentery and hepatic abscess are frequently associated, this association is very rare except in the tropics; nor is it there very constant. Thus dysentery is extremely common in children, while abscess of the liver is equally rare among them; indeed, abscess of the liver is very unusual under the age of twenty, and is more common after the age of twenty-five than below it. The proportion of cases in which liver-abscess and dysentery are associated is extremely variable; it is more frequent in one year than in another, and also at one period of the year than at another. Although dysentery is the commoner affection, yet occasionally the number of cases of hepatitis, with a certain proportion of deaths from abscess, may greatly exceed the number of cases of dysentery. There are many fatal cases of abscess in which the bowels have been found perfectly healthy; abscess of the liver, on the other hand, can scarcely be considered to be very frequent in dysentery. Yet dysentery and abscess of the liver seem to arise in the tropics from very much the same causes; and something is there impressed on the constitution which seems to render the system, even for some years after a return to Europe, somewhat inclined to liver-abscess.

Abscess of the liver is an occasional result of pyæmia, and connected at times with surgical operations, especially with those performed on the rectum. It has been induced by falls or by direct violence; or by the impaction of a gall-stone, especially where it has been rough and spicular.

The *predisposing* causes are the same as those of hepatitis—drinking, irregular life, exposure, and residence in the tropics.

ANATOMICAL CHARACTERS.—The course of formation of hepatic abscess seems to be the following:—The liver is first loaded in some portion or portions with an excess of blood; then follows exudation of lymph and pus, forming small deposits, of which two or three coalesce, while the liver-substance breaks down. The abscess extends in this mode. It is usually lined by a membranous cyst, which is very thin when the formation of the abscess has been rapid, and of greater consistence when the abscess is old. The abscess may be of almost any size, from that of a small orange up to a huge cyst containing ten or twelve pints of pus. Six hundred ounces of pus have been withdrawn from an abscess in five months. Most commonly the abscess is single, but frequently there are several abscesses. They are most common in the right lobe. They may have reached the surface or have burst, or they may be only discoverable on making an incision into the organ after death. In the great majority of cases, if the abscess has not been exposed to the air, its contents are laudable or healthy, inodorous pus. In some cases the pus is of the colour of chocolate. It is said that streaks of bile have sometimes been observed. Slight pinkish streaks are not so rare. An abscess may open through various channels. Sometimes it finds its way to the surface, and discharges itself through the skin. This usually happens lower down than the ribs. The abscess may open into the peritoneal cavity, and has done so into the pericardium. In such cases the result is fatal. It passes occasionally into some portion of the bowels, and as this causes the least constitutional disturbance, it is a favourable mode of discharge. Very frequently, when the abscess is near the convex side of the liver, the diaphragm and the surface of the liver become adherent—as in this case the abscess has not usually been very deep-seated—and the abscess opens itself through the lung. This offers a fair

chance of recovery. There are still other possible points of exit, but these are chiefly matters of curiosity.

When the abscess has burst, cicatrisation commences, and has sometimes been traced when the case has terminated fatally. But it is remarkable that well-marked cases of complete cicatrisation have not often been recorded—various membranous formations and slight depressions in the liver being now considered to be the results of syphilitic hepatitis. There is a strong presumption that liver-abscess is occasionally absorbed without having ruptured, and also that it may remain latent for a long period. In cases where the abscess has been partially absorbed, a white fibrous sac has been found, containing a little pus and sometimes cheesy matter; and in some cases in which there has been strong presumption that the abscess had existed for four or five years, the walls of the abscess have been found much thickened, and almost cretaceous. Although a portion of the liver has been converted into abscess, the remaining portion of it may be healthy, or somewhat indurated from former attacks of congestion; and it is wonderful how in favourable cases, where the contents of an abscess have been absorbed or evacuated, the remaining healthy portion of the liver executes its work.

In addition to the formation of ordinary hepatic abscesses, suppuration may take place extensively throughout the liver, after lobular hepatitis, as in a case recorded by Dr. Quain (*Path. Soc. Trans.* 1853); and also in the portal canals, or beneath the investing capsule of the liver.

Symptoms.—These are more urgent when acute hepatitis runs into abscess, than when abscess is the consequence of repeated attacks of illness, as is most commonly the case. The general symptoms are a pale, muddy complexion; a look of anxiety, and a state of low, irregular feverishness, the pulse being generally about 100, and the temperature increased by a degree or two. There may be one or two shivering fits, or accesses of fever simulating ague. The appetite is impaired; there is vomiting, with irritability of the stomach; the tongue has generally a white coating, but in some cases is almost clean. The throbbing pain which usually accompanies the formation of pus is scarcely ever present. There is occasionally pain in the shoulder or shoulder-blade, but this is uncertain. A certain amount of pain, usually dull, is felt in the liver, often increased on pressure; attended with more or less, and sometimes with very considerable, enlargement of the organ. There is also fulness or bulging of the right side; and at the last, possibly, fluctuation. If abscess form on the upper side of the liver, there is more or less pressure on the diaphragm, causing shortness of breath, and occasionally leading to local inflammation, attended with acute pain. But such symptoms, which are more valuable taken collectively than individually, may not be present in a marked degree. The state of the biliary secretion is very often normal, or nearly so; and the condition of the urine offers no certain indication, although bile-pigment is sometimes present in it. Jaundice is comparatively rare. In some of its more insidious forms, hepatic abscess may come on without being preceded by fever or ushered in by shiverings; but even in such cases a general falling off of the health is always observable.

As has been already pointed out, the abscess may burst in various directions; or it may be opened by a surgical operation. As a general rule the result is more favourable—probably because the opening being small the pus escapes gradually—when the abscess finds an opening for itself, than when it is evacuated artificially. In the latter case the discharge usually lasts for some months—nay, for more than a year in some instances; and although the patient improves up to a certain point, he is very likely to sink in the end. When the patient sinks, it is usually from general exhaustion of the system. Pyæmia is of extremely rare occurrence.

Complications.—Abscess of the liver is often complicated with dysentery, or with diarrhœa; and less frequently with malarious fever. Sometimes there is a certain amount of pleurisy or pneumonia. This is more frequent in acute cases than when the formation of abscess has been slow.

Diagnosis.—A positive diagnosis is difficult to make in the early, and sometimes in the later, stages of hepatic abscess. The writer has known an iron-worker burst an abscess through his lungs when at work, the presence of which was not suspected; also a medical man submit his side to examination by several of his brethren, bear any amount of pressure, and yet die two days after choked by the bursting of an abscess. Nevertheless, an experienced physician will from the symptoms be able to guess the presence of abscess of the liver before any palpable signs appear. These are, first, the general aspect of the patient; then the enlargement of the side. It is only in a more advanced stage that fluctuation can be made out. As to the diagnosis after the abscess has burst, if it breaks through the lung the peculiar chocolate-colour expectoration is at once characteristic. If the abscess bursts into the pleura or peritoneum, the diagnosis is not so positive, but the sudden collapse usually shows what has happened. When the abscess bursts through the bowels, especially in small amounts at a time, the fact is rarely recognisable, except by the gradual improvement of the patient. It seems to be certain that hepatic abscess has sometimes been confounded with a distended gall-bladder: with care, however, such a mistake can scarcely happen. It may be confounded with cancer or with hydatids of the liver; but in these affections—and particularly in the last—there is very little constitutional disturbance, and in cancer a nodular protuberance may very generally be recognised. The only other mistake that is occasionally made is, that of confounding abscess and the effects consequent on its presence, when it points upwards, with pneumonia or pleurisy near the base of the right lung; but with careful auscultation the affection of the lung or pleura ought to be made out by their physical signs.

Prognosis.—This is generally very unfavourable. Yet there is always a chance of recovery if the pus finds for itself an exit, as through the bowels or lungs, or even if exit to it is given

artificially. The statistics of the results of making artificial openings are not very encouraging. The operation, however, frequently appears to prolong life. The most favourable mode of exit is through the lungs. The discharge of pus may continue for six months, and yet recovery take place. Absorption of the abscess probably sometimes occurs, though this is a very rare termination. Such absorption is, obviously, chiefly a matter of inference. If a patient recovers from an attack of liver-abscess, his health may return to its usual standard. There is reason to believe that individuals have lived thirty or forty years after the occurrence of abscess; and the writer knew a man of 75, who had had abscess forty-five years before.

Treatment.—To avert the formation of abscess, the ordinary treatment for hepatitis is the only one that can be adopted. When abscess has once formed, or even whenever there is good ground for suspecting this, the time for all active treatment has gone by. The patient must have his strength supported by mild nutritious diet and wine. He must be treated symptomatically. Usually it is sufficient to secure regular action of the bowels, and thus help the sound remaining portion of the liver to perform its function. Mineral acids, quinine, and other tonics, may all be useful. Counter-irritation over the liver is often tried, but it may be doubted whether in this condition of things it is a measure of any importance, although some think that it may help to limit the extent of the abscess. The course of the disease must be watched. The only mode of interference that we can pursue is that of helping to give exit to the contents of the abscess. Towards expediting this little can be done until fluctuation becomes evident, and then interference is to be delayed as long as possible, as nature will probably select the most convenient spot for the exit of the pus, and, after all, the presence of other undetected abscesses in the liver may make operative procedure useless. The abscess may point in an intercostal space, below the edge of the ribs, at the epigastrium, and even as low down as the umbilicus. A great deal has been written about modes of opening the abscess, and of ascertaining first whether it has formed adhesions, and various modes have been suggested for ensuring adhesions. However these are not matters of much practical importance. It is usual to make an opening whenever there is distinct bulging between the ribs; but it is better, when it is at all possible, to wait and operate, if it can be managed, below the ribs. However near the surface the abscess may appear to be, a lancet is seldom sufficient, and a good-sized trochar and canula should be employed. The aspirator, and everything that will help to prevent the introduction of air, should be taken advantage of, and the precautions of the antiseptic method most strictly observed. For there is always a chance of gangrene after a time supervening round the opening, and the risk of this seems to be greater the higher up the opening is made. The evacuation of an abscess usually produces amelioration of the general condition, whether it be permanent or not.

Change of climate may operate favourably when the patient is suffering from the long-continued drain of an open abscess; and if we are to judge by the number of patients suspected of having liver-abscess who have been sent to sea and who have arrived in Europe with their symptoms relieved, we may almost venture to say that a long sea-voyage under favourable circumstances assists absorption. In favourable cases the sequelæ of liver-abscess must be treated like those of hepatitis. J. Macpherson.

LIVER, Albuminoid Disease of.—Synon.: Fr. *Dégénérescence amyloïde du Foie*; Ger. *Amyloide Entartung der Leber.*

Definition.—A disease characterised by painless, more or less considerable, enlargement of the liver; due to the existence in its structure of a peculiar homogeneous substance, the exact nature of which is not known, but which has a marked relation to certain cachexias and constitutional maladies.

Ætiology.—Albuminoid disease of the liver occurs in association with certain cachexias, especially those of constitutional syphilis, scrofula, rickets, scrofulous diseases of bones and joints, and other diseases attended with protracted suppuration. It has been noticed in connection with chronic dysentery, but the records of the Seamen's Hospital do not confirm such association. In many cases of chronic ague, with marked cachexia, which have been admitted into the hospital just named, there was an enlarged, hard liver, pointing to albuminoid change; but there was probably in these cases the superaddition of syphilitic taint. Rokitansky speaks of the disease as congenital in children born of syphilitic parents.

Anatomical Characters.—The liver has its normal shape; is more or less enlarged, sometimes to such an extent as to fill the greater part of the abdominal cavity; and is hard, resistant, and inelastic, with a smooth glistening surface. The organ cuts like bacon, hence the name 'lardaceous.' The cut surface is grey, or fawn-colour, or pale red; but sometimes it is yellowish, and this appearance, in conjunction with the consistence of the organ, has led to the name 'waxy.' From the incised veins a little pale blood usually oozes. The application of solution of iodine to the cut surface causes change of colour, which has been described as blood-red, reddish-brown, mahogany brown, walnut, by different observers. The addition of sulphuric acid induces a blue colour, best seen in a delicate section placed under the microscope. Supposing a lobule of the liver to be divided into three zones, the characteristic iodine stain will be seen, in less advanced stages of the disease, to be limited to the middle zone, where the hepatic artery is distributed: the vessels and cells here being filled with the new material, which afterwards may extend so as to implicate the entire lobule. The structures invaded by the new material have, in a section examined microscopically, a lustrous, transparent, and somewhat swollen appearance. When the entire lobule is affected, the aspect is homogeneous. The appearance of an albuminoid liver may be modified by the co-existence of fatty change, or cirrhosis, or syphilitic disease. The spleen is generally, and the kidneys are occasionally, im-

plicated. Cornil has used some new colouring matters, namely, two methyl-anilin violets, discovered by Lauth, and a violet discovered by Hoffman, as tests of albuminoid degeneration. The normal tissues of the liver and other organs do not decompose the violets, but when amyloid degeneration is present, the affected parts become of a violet-red, the normal structures assuming a violet-blue tint. In the examinations of specimens by Cornil the hepatic cells were unaffected, a result in opposition to generally received views, as just stated, and to his own previous investigations. In all cases the walls of the capillaries, or of the hepatic arteries and veins, were affected. Methyl-green has been more recently used for the same purpose.

Symptoms.—Palpation, in marked cases of albuminoid disease of the liver, will readily detect a large, hard, resistant tumour, having the normal outlines of the liver; the smoothness of its surface; and the extent to which it encroaches upon the abdominal cavity. Pressure does not elicit any tenderness, nor is there usually any pain; at most, in advanced cases, there is only a sense of tension and fulness, as in other hepatic enlargements. The painless nature of the tumour is distinctive. The disease does not interfere with the portal circulation, and does not therefore directly cause ascites. When this occurs it is the result of general cachexia, induced by the constitutional malady, and perhaps by associated renal complication. The dropsy generally affects the legs in the first instance, and afterwards the serous cavities, and is not a prominent symptom unless the kidneys are implicated. In this case the urine is usually of low specific gravity and albuminous, and the anæmia very marked. The system of bile-ducts not being obstructed by the disease, there is no jaundice; or if this occur, which is a rare event, it is from pressure on the duct externally by enlarged lymphatic glands. The evacuations are, however, frequently of a pale yellow, and at times of a clayey, colour, which may be accounted for by the extensive impairment of secreting structure, and the consequent secretion of a poor, colourless bile. A lardaceous state of the spleen is a frequent accompaniment of the liver affection, and gives rise to increased volume and hardness of the organ, which may be detected by palpation in the left hypochondrium. Vomiting, without the usual indications of gastric derangement, as furred tongue, &c., and diarrhœa, are symptoms not uncommon in advanced cases, and are due, according to Frerichs, to the implication in the disease of the vessels and villi of the stomach and intestines.

Diagnosis.—The peculiar features of the enlargement, its painless character, the concurrence of the constitutional maladies already noticed, especially if with implication of spleen and kidneys, will distinguish this from other hepatic enlargements. If there be associated cirrhosis or syphilitic disease, the diagnosis will be difficult; but, as Bamberger remarks, an error will not be of moment as regards prognosis and treatment.

Prognosis and Duration.—The disease may run on for months or even years, but it generally proves fatal, either by intercurrent affections or by anæmia, general dropsy, and exhaustion, such result being more rapidly determined when the kidneys are involved, In the early stage of the malady an arrest of mischief, if not a cure, may possibly be effected.

Treatment.—It is only in the earlier stages of albuminoid disease of the liver that treatment can avail, and then it must be directed especially to the associated cachexia. Whether this be syphilitic or strumous, the preparations of iodine are indicated; the iodide of potassium, the tincture of iodine, or, where the anæmia is marked, iodine in combination with iron. The syrup of iodide of iron in drachm doses, three times a day, has proved useful, if not in reducing the tumour, at least in improving the general condition of the patient. The iodine mineral springs, as Woodhall Spa, Kreuznach, Adelheidsquelle, &c., are indicated, although they contain but infinitesimal doses of iodine and bromine. The baths of Aix-la-Chapelle, Ems, and Weilbach have each had their supporters in the treatment of this malady. Hydrochlorate of ammonia, in ten to twenty grain doses, three times a day, continued for some time, has been found to be efficacious in reducing large, hard livers (Budd, Begbie). The general therapeutical indications are pure air; plain, nourishing diet; the regulated use of alcoholic stimulants; and adequate protection of the skin by warm clothing and other measures. Stephen H. Ward.

LIVER, Apoplexy of.—By this is meant hæmorrhage in the liver, in the form either of isolated patches of extravasation or of general effusion, the whole of the hepatic parenchyma being converted into a dark-red pulpy mass. This affection is rarely met with in this country, but has been often observed abroad in warm climates and malarious districts, as a result of disease of the liver, or prolonged and intense congestion. It occurs also in some cases of scurvy. Abercrombie believed that the puerperal condition predisposed to hepatic apoplexy. It has been observed also, according to Frerichs, in some new-born infants after long labours, and in cases of this kind it is usually associated with pulmonary atelectasis. A rapidly fatal case of hepatic apoplexy was reported by Andral, in which there were no indications of any efficient cause of the hæmorrhage. (*Clin. Med.*, 3 ed., t. ii., p. 259.) Extravasation of blood into the substance of the liver, together with a pulpy condition of more or less of the parenchyma, may be produced by the application of violence to the hepatic region.

Symptoms.—The symptoms that have been observed in cases of hepatic apoplexy are pain in the right hypochondriac region, and excessive tenderness; jaundice; bilious vomiting; melæna; a cold and bloodless condition of the skin of the face and limbs; and in some cases syncope.

This affection is almost invariably fatal when due to prevailing disease of the liver, or to extensive laceration. W. Johnson Smith.

LIVER, Atrophy of, Acute Yellow.—Synon.: Fr. *Atrophie jaune aiguë du Foie*; *Ictère grave*; Ger. *Acute Atrophie der Leber.*

Definition,—This is a general disease, likened by Trousseau to a pyrexia. The jaundice, being

so prominent a symptom, formerly drew attention too exclusively to the liver; but the same degeneration which seizes upon the liver, likewise attacks all the glandular and muscular organs of the body. The morbid change is a parenchymatous degeneration, called by Virchow and his school a parenchymatous inflammation. It consists in a filling of the cells of a gland with albuminous granules, in such numbers as altogether to hide the nucleus; the albuminous granules are quickly followed by oily particles and drops. In the muscular tissue, the striation is lost, and its place taken by granules, placed irregularly or running lengthwise. These morbid appearances are found in poisoning by phosphorus, arsenic, antimony, alcohol, and other agents, and in all fevers, though in a less degree than in acute yellow atrophy. Buhl was the first to point out that the pyrexial changes were the beginnings of acute yellow atrophy.

Ætiology.—Acute yellow atrophy is perhaps the rarest of all the diseases common to this climate. Of its causes, next to nothing is known. It seems to be more common in women than in men; and in pregnant women than in others.

It has been shown that in pregnant and suckling quadrupeds and laying hens, the liver and kidneys often show cells infiltrated with fat, a fact which may throw some light on the disposition of pregnant women to acute yellow atrophy. Emotional disturbances, such as grief and trouble, and bad hygienic conditions, have been thought by some to predispose to this disease. Others believe that all cases may be traced to phosphorus-poisoning.

Anatomical Characters.—After death it is not uncommon to find the liver of natural size, or even enlarged, in the early stages of acute atrophy. Later on the organ shrinks, so that in extreme cases it may weigh as little as nineteen ounces. It decreases in all diameters, but the left lobe is especially shrunken. The capsule is often wrinkled. On section, there is no longer any appearance of lobules, but an ochre-coloured surface without definite structure, but often reddened. Under the microscope, the liver-cells are found, in the early stages, to be filled with granules, so as completely to hide the nucleus; part of these granules are soluble in acetic acid, others are not. Later on, all trace of liver-cells may be lost, nothing but a granular and oily detritus and pigment being seen under the microscope. If the organ be set aside, it often becomes covered with crystals, stated by Frerichs to consist of leucin and tyrosin.

The spleen is enlarged and soft in the great majority of cases. The stomach and alimentary canal are filled with dark-red or tarry contents, the outcome of hæmorrhage; the tubular glands of the stomach are filled with fattily degenerated epithelium. The muscular tissue of the heart shows likewise fatty degeneration; and the tubules of the kidneys are filled with epithelium in various stages of fatty degeneration.

Symptoms.—Acute yellow atrophy is commonly preceded for some days or weeks by a simple jaundice, in which nothing peculiar can be made out. Delirium and convulsions then suddenly set in, followed by deep coma, stertorous breathing, and dilated pupils. During the first part of the disease the pulse is natural in frequency, but with the appearance of the convulsions and delirium it rises to 120 or 130. The skin is always yellow, rarely deeply coloured. The urine is natural in quantity, bilious, containing leucin and tyrosin, and towards the end of the disorder, containing no urea, chlorides, or phosphatic earthy salts; a kind of peptone is present. There is almost always constipation; the stools being at first pale, afterwards black from admixture of blood. Vomiting is very constantly present; at the end of the disease, of a black coffee-ground matter. The right hypochondriac and epigastric regions are painful and tender. The liver, at first natural in size, or even larger than natural, decreases daily in dimensions, so that at last percussion may give no liver-dulness at all. With the decrease of the liver, the spleen increases in size. A hæmorrhagic diathesis likewise sets in, as shown by petechiæ on the skin, epistaxis, hæmatemesis and melæna. The temperature is commonly low, until just before death.

Diagnosis.—The diagnosis is beset with difficulties, and may remain doubtful even after death. Poisoning by phosphorus can hardly be distinguished from acute yellow atrophy, unless the patient own to having taken the drug. The prodromal stage cannot be distinguished from simple jaundice.

Prognosis.—The prognosis is extremely bad: only a very few suspected cases are known to have recovered.

Treatment.—The treatment must be conducted upon general principles. A few cases, in which the diagnosis of acute yellow atrophy has been thought justifiable, have recovered, and these have been treated with the mineral acids and purgatives, aconite, quinine, and camphor. These are therefore the remedies which may be recommended to be used. Local symptoms, such as vomiting or bleeding, must be treated as in other diseases. J. Wickham Legg.

LIVER, Atrophy of, Chronic.—Chronic atrophy of the liver is seen in many wasting diseases, and in old age; the liver then often shrinks, becoming tougher in consistence, but rarely granular on the surface. The cut surface is dark red or pale brown; the acini are either invisible, or else smaller than natural. Frerichs thinks that the blood-vessels are all dilated. The increased toughness seems due to the atrophy of the liver-cells, the meshes of the connective-tissue network being thus brought nearer to each other.

The symptoms of chronic atrophy are merged in those of the primary disease, against which all treatment must be directed.

J. Wickham Legg.

LIVER, Biliary Accumulation in.—Anatomical Characters.—When a permanent obstruction to the flow of bile into the duodenum has been set up, serious changes take place in the gall-ducts and the liver itself (*see* Gall-Bladder and Gall-Ducts, Diseases of). At first the liver swells, apparently from the pent-up secretion. It becomes of a deep bilious or olive-green colour, the central parts of the acini being the deeper coloured; on section the dilated

ducts are seen, and bile or a colourless fluid wells out of them. Increase in the consistence of the liver commences; and if the obstruction continue, the organ wastes, becomes much tougher, and shows a granular surface. This increase in consistence is due to an overgrowth of the connective-tissue of the liver, as in cirrhosis, only to a less degree. The amount of over-growth depends upon the kind of obstruction. It is greater when a rough angular gall-stone is the cause, than when an hydatid tumour with its smooth walls presses upon the gall-ducts. This overgrowth springs at first from the gall-ducts, which are greatly thickened, and thence spreads over the connective tissue of the portal canals.

The liver-cells atrophy, as in cirrhosis. They vary much in size. Their contents seem to be chiefly fat and pigment-granules, though neither is of very great amount as a rule. The arrangement in rays around the hepatic venule is quite lost. One of the most important functions of the liver is the preparation of glycogen, and this function seems to be abolished in long-continued jaundice. In animals whose bile-ducts were tied, the writer found the glycogen to disappear not many hours after the ligature was applied; and after puncture of the fourth ventricle, no sugar appeared in the urine.

In some cases of complete obstruction to the bile-ducts, the liver-cells have been found altogether destroyed, nothing but a fatty detritus being seen under the microscope. This is not owing simply to *post-mortem* changes in the liver; but is possibly due to the long-continued action of the bile-acids circulating in the blood upon the liver-cells themselves, as Leyden has pointed out. It is not owing to the simple solution of the liver-cells in the bile, for the bile has not the power of dissolving these cells, as Th. von Dusch has asserted.

Symptoms.—As regards the clinical phenomena of biliary accumulation in the liver, there are, of course, all the symptoms of jaundice and of the disease which leads to it. In addition, the liver at first swells, and may be detected below the ribs for two or three fingers' breadth, but rarely more; it is often painful on palpation. Later on, the liver retreats within the boundaries of the chest. Ascites often shows itself, owing to the disturbance of the circulation in the liver; and the spleen often swells. All these symptoms are, however, liable to be interfered with by the primary disease.

Treatment.—The treatment must be directed to the cause of the obstruction of the ducts.

J. Wickham Legg.

LIVER, Cirrhosis of.—Synon.: Granular liver; Hobnailed liver; Gin-drinker's liver; Interstitial hepatitis; Fr. *Cirrhose du Foie*; Ger. *Cirrhose der Leber*.

Definition.—A chronic disease of the liver, in which the organ becomes hardened, and usually more or less diminished in size, at the same time assuming a granular or hob-nailed appearance; these changes resulting from an increase in the connective-tissue, usually caused by abuse of spirituous liquors. The name *cirrhosis* was first given by Laennec to the hardened and shrunken liver, on account of the yellow colour of the granulations in this disease.

Ætiology.—The most common cause of cirrhosis is, undoubtedly, the abuse of spirituous liquors. Spirits, unmixed with water, seem to be more potent in causing cirrhosis than wine or malt liquors. Next after these, but at a great distance, come syphilis, and the immoderate use, it is said, of spices—such as curry, or of coffee. In some rare cases no cause is apparent. The disease is far more common among men than women; it is very rare indeed amongst children. In one of these cases, the child asked the nurse for gin soon after admission into the hospital. Cirrhosis has also been seen among the lower animals, a proof that alcohol is not the sole cause.

Anatomical Characters.—The seat of the disease in cirrhosis is the capsule of Glisson. The connective-tissue, which accompanies the vessels entering at the portal fissure, and which forms a covering for the liver beneath the peritoneum, takes on a very active overgrowth. One result of this overgrowth is a compression and atrophy of the secreting cells of the liver. Another is a hindrance to the flow of blood through the liver; for, although new vessels do indeed form in the new connective-tissue, yet these are by no means enough to carry on the circulation, in the place of those obliterated or destroyed by the advancing overgrowth of connective-tissue.

There are several varieties of cirrhosis. In the first—that which is most common—the liver is shrunken, it may be to one-half or one-third of its natural size. This shrinking is often greatest in the left lobe, so that this may become a mere appendage to the right. At the sharp edge of the liver, there is often nothing left but a semi-transparent tissue, containing none of the elements of the gland. False membranes often join the surface of the liver with the diaphragm or other neighbouring parts. The surface itself is greatly roughened. It shows numberless granulations, varying in size from a poppy-seed to a hazel-nut. The fibrous investment of the liver is greatly thickened; and the peritoneum tears off either in layers, or leaving a granular surface behind. The liver is exceedingly hard and tough; and on section, the cut surface is seen to be made up of yellow islets, imbedded in a white translucent tissue. These yellow bodies are the representatives of the granulations seen on the outer surface, and they are the remains of the natural liver-tissue, separated from one another by the new white connective-tissue. This is by far the commonest variety of cirrhosis, but there are others. One form is *hypertrophous* cirrhosis, in which the liver is greatly increased in size, sometimes more than double its natural weight; but the surface is smooth, and the capsule, though thickened, leaves a smooth surface when torn off. There is toughening of the liver, though not to so great a degree, and the same appearance of the cut surface as in ordinary cirrhosis. In another variety the organ is shrunken, but the surface is smooth, and on section are seen only pins'-points of yellow tissue in the white translucent overgrowth. Whether the hypertrophous variety ever becomes shrunken is still undecided. A third variety is *fatty* cirrhosis, which may be

mistaken at first sight for fatty liver, but the touch shows how tough it is. It sometimes floats in water. There is no everted edge, and on section no acini are to be made out; but the cut surface is indistinct, pale, and yellow. The surface of the liver is smooth.

Under the microscope, using a low power, the tissue of the cirrhosed liver is seen to be broken up into islets, separated by broad bands of what looks like a highly nucleated connective-tissue. The separation between the two appears sharply defined. In some cases the liver-cells may be seen infiltrated with fat. With higher powers, the most striking object in the field is the great abundance of what were once called nuclei, but now lymphatic corpuscles, in the new-formed connective-tissue: these vary little in size or shape, being nearly all round or roundish. The prevailing opinion now is that they are emigrated leucocytes. They are arranged sometimes in clusters, sometimes in lines, and sometimes indefinitely. The origin of the clusters is uncertain; but it seems tolerably clear that the linear disposition arises from the obliteration of vessels carrying bile or blood. The connective-tissue itself is highly fibrous; sometimes homogeneous or granular. The liver-cells themselves undergo great changes. They lose their natural polyhedral shape, and become oblong, oval, or spindle-shaped. Between them the new connective-tissue gradually insinuates itself, and the cells become lost in the advancing overgrowth. These changes in the liver-cells are of course best seen at the spot where the liver-tissue and the connective-tissue join.

Symptoms.—The first approaches of cirrhosis are commonly very insidious. Often one of the first symptoms is a dull pain in the neighbourhood of the liver. This is accompanied by signs of a chronic gastric catarrh, of which morning sickness is, for the diagnosis of intemperance, of the greatest importance. The patients are commonly of a sallow, often almost jaundiced, complexion. They grow thinner, and their strength fails. Some patients suffer from piles: in others diarrhœa occurs. Later on the belly begins to swell, and ascites appears; the legs may become œdematous, from the pressure of the fluid in the belly on the anterior wall of the inferior vena cava. The urine is high-coloured; often deposits urates; and sometimes contains albumin from contracted kidneys.

An important point in the diagnosis is to determine whether the liver is of small size, and growing smaller. This is often difficult, on account of the ascites; the difficulty may sometimes be overcome by laying the patient on his left side. In the earlier stages the hard edge of the liver may at times be felt, and even though the ascites be great, by suddenly depressing the walls of the belly with the fingers. The percussion-dulness of the liver in the nipple line may be reduced to two inches or even one inch in height.

Although in the new-formed connective-tissue of cirrhosis fresh vessels form to take the place of those obliterated, yet these by no means suffice to carry on the circulation through the liver. Portal obstruction therefore arises, which relieves itself in various ways; most commonly fluid is poured out into the cavity of the peritoneum, causing an ascites, or into the cavity of the intestines, causing a diarrhœa, which should not be lightly checked. In other cases it is relieved by hæmatemesis, or by hæmorrhoidal discharge. That which is most fortunate for the patient is the formation of a varicose communication between some radicles of the portal system and the general veins; as between the hæmorrhoidal and the hypogastric, the veins of the stomach and the œsophageal. Most important of all, however, is a vein discovered by Sappey. It arises from the left branch of the portal vein, and passes up the falciform ligament close to the ligamentum teres to join the epigastric and internal mammary veins. It is by no means the same as the old obliterated umbilical vein, although so near to it. The vein just mentioned will often be found dilated after death.

As a rule the spleen is enlarged in cirrhosis. The enlargement may be very great, but the organ is commonly about twice or three times the natural size. After death the spleen is found of softer consistence than natural, sometimes pulpy. The cause is obscure; the reason commonly given is the hindrance to the flow of blood through the liver acting on the splenic vein. The spleen, however, does not always swell when there is obstruction to the portal circulation, for example, in nutmeg-liver.

Ascites is a symptom which sooner or later is sure to come on. It appears to arise from the venous stasis in the subperitoneal tissues. Fluctuation, and the movement of the fluid on change of posture are very clear. The fluid, like all other dropsical effusions, contains albumin, salts, sometimes urea, sometimes sugar; and in jaundice bile-pigment. After the ascites has set in, the feet may begin to swell, from the pressure of the fluid on the vena cava. The upper limbs and face are free from œdema. In some cases albumin is present in the urine, from coincident Bright's disease.

The patients often complain greatly of flatulence, which adds much to their distress, and dyspnœa. Hæmatemesis and piles are of frequent occurrence. Diarrhœa when it comes is, as above mentioned, salutary, and should not be checked unless extreme. The urine is scanty and high-coloured; often turbid from urates; and bile-pigment is present when jaundice sets in. Jaundice may or may not be seen, according as the pressure of the new connective-tissue does or does not involve the bile-ducts.

Diagnosis.—The diagnosis depends upon the history of intemperance; the size and consistence of the liver; the size of the spleen; and the appearance of ascites and other dropsies. Of importance also is the peculiar sallow earthy complexion; and the occurrence of hæmorrhages from the stomach or intestines. The diagnosis is often easy; while at other times it is very hard or well-nigh impossible to make. Cirrhosis may be confounded with portal thrombosis; obliteration of the hepatic duct; nutmeg-liver; syphilitic disease, cancer, or hydatids of the liver; and chronic peritonitis.

Prognosis.—It is rare for a patient suffering from cirrhosis of the liver to live longer than a twelvemonth after the symptoms have become so pronounced as to allow a diagnosis to be made.

Death is in nearly all cases the end of the disease.

Treatment.—In the early stages of cirrhosis it is most important to induce the patient to give up his habits of intemperance, for without this, treatment will be of little avail. Next the use of alkaline purgatives, with or without vegetable bitters, such as chiretta or calumba, will be very useful. A course of the waters of Carlsbad is often most useful, or other alkaline or iodised waters. The diet must be mild; and exercise on horseback or on foot should be recommended.

In the later stages of the disease the great object will be to keep up the strength of the patient. For the ascites, which often becomes the patient's great trouble, diuretics, especially copaiba, and mercurial alteratives may be employed. Paracentesis should be put off as long as possible, as the end of the disease often arrives soon after the tapping, though in some cases the ascites is cured by this operation. The flatulence should be combated by regulation of diet, charcoal, small doses of hydrochloric acid, and carminatives. The bowels must be kept open, but not severely acted on.

J. Wickham Legg.

LIVER, Congestion of. *See* Liver, Hyperæmia of.

LIVER, Contraction of.—A small liver is met with in cirrhosis, in nutmeg-liver, and in long-continued obstruction to the gall-ducts, in all of which an over-growth of the connective-tissue of the capsule of Glisson is seen. Any kind of pressure on the liver from neighbouring organs will likewise beget wasting. A small liver is seen in old age, and in the marasmus of wasting diseases. The liver likewise wastes if the portal vein be obstructed, or the capillaries in the liver be obstructed, as in pigmented liver. A shrunken liver cannot be looked upon as a disease by itself. J. Wickham Legg.

LIVER, Enlargements of.—Anatomical Relations.—In proceeding to determine whether the liver is enlarged or not, the following points must be remembered. Normally, the dull sound yielded by percussion extends upwards in front, in a line drawn towards the nipple, to about the sixth rib; laterally, in the axillary region, to the eighth rib; and by the side of the spine, to the eleventh rib. The lower border of the liver corresponds in front and at the side to the lower border of the ribs; and the dulness behind merges into that caused by the right kidney. The left lobe of the liver extends across the epigastrium to the left of the mesial line; the dull sound caused by its upper border merging in that produced by the heart. The upper part of the convexity of the liver rises to a little more than an inch above the sixth rib, the lung dipping down in front, and giving rise to a modified percussion sound; but for practical clinical investigation it is better to take the line of absolute dulness. The extent of the dull sound from above downwards in the right mammary line is nearly four inches, and at the side about four inches and a half. In the middle line in front it extends from the base of the ensiform cartilage to about two fingers' breadth below its point. It should be remembered that the limits of the liver present, compatibly with health, considerable variation; that the organ is relatively larger in early than in adult life; that it is depressed in inspiration, and ascends in expiration; that it is somewhat lower down in the erect than in the recumbent position; and that there is temporary distension during digestion.

Diagnosis.—There are various sources of fallacy which may lead to an erroneous conclusion as to the size of the organ. Thus, an intestine distended with flatus may get in front of the anterior border of the organ, and lead to the supposition that there is contraction, when the contrary is the case. When there is ascites to any extent, it is difficult to make out the boundaries of the liver. In this case, however, by placing the patient on the left side, so as to let the fluid gravitate in this direction, a diagnosis may often be effected; also, by suddenly pressing the finger down below the ribs, and thus displacing the fluid, one may sometimes detect the enlarged organ. A rigid right rectus muscle is liable to be taken for a tumour; to obviate this source of fallacy, the patient should lie on his back with his thighs drawn up, and his attention should be diverted by conversation whilst the examination is being made. Sources of fallacy may exist in the liver itself, as in malformations or malpositions of the organ; or they may be outside it, either in the abdomen or chest. Malignant disease of the stomach, omentum, or pancreas; a kidney greatly enlarged by cancerous deposit; or fæcal accumulations in the colon, may be mistaken for hepatic enlargement. The following considerations will assist in arriving at a correct diagnosis—(*a*) enlargements of the liver, however much they may extend beyond, generally occupy the normal site of the organ, and however irregular the surface, the usual outline may be traced; (*b*) such enlargements usually follow the movements of the diaphragm in full respiration. Effusion into the right pleura may be mistaken for enlarged liver, especially as this organ may be depressed by it, and so appear to extend beyond its limits in the downward as well as in the upward direction. In pleuritic effusion, however, the dulness on percussion will vary with the position of the patient, and the upper line of dulness will in effusion be straight, in hepatic enlargement convex. Pleuritic effusion and hepatic enlargement may, however, co-exist. Pneumothorax, emphysema of the right lung, thoracic tumours, and even extreme pericardial effusion, may depress the liver, and affect the diagnosis.

Enumeration.—Dr. Bright arranged enlargements of liver under two heads, according to the surface of the organ, namely, smooth and irregular. Dr. Murchison considered this classification open to the objection that an enlargement usually smooth is at times irregular, and *vice versâ*, and he proposed the division into painless and painful enlargements; but to this similar objection may be taken. The principal enlargements of the liver are associated with the following diseases of the organ.

1. *Hyperæmia or Congestion.*—The enlargement is not usually, particularly in acute cases, very great; but in chronic cases, and in conges-

tion from obstruction to the circulation, it is often considerable, the organ extending downwards nearly to the umbilicus, and across into the left hypochondrium. The normal contour of the liver is preserved; the surface is smooth; and the resistance is increased. Pain and tenderness are often present, especially in acute congestion.

2. *Obstruction of the bile-ducts.*—Obstruction of the bile-ducts, whether temporary from inflammation or impaction of gall-stones, or persistent, will be attended with some enlargement, smooth and normal in shape, of the liver; with, perhaps, also, distension of the gall-bladder, causing a pyriform tumour, which projects downwards from the anterior border of the liver, and is, in some cases, of considerable size.

3. *Abscess.*—The presence of numerous pyæmic abscesses in the liver will give rise to an enlargement of the organ, with tenderness on pressure over the right hypochondrium. Tropical abscess, when deep-seated, may give rise to like results; but when large and near the surface will, if under the ribs, cause prominence of the right hypochondrium, with obliteration of the intercostal spaces; or when pointing below or to the left of the ribs, will present an elastic, fluctuating tumour, with, perhaps, redness of surface.

4. *Hydatid disease.*—Hydatid of the liver is marked by nearly the same physical signs as abscess; a large hydatid cyst causing, according to its site, either bulging of the right hypochondrium, or an elastic tumour either below or to the left of the right lower ribs. The tumour in some cases gives a sense of fluctuation, and the peculiar vibratory tremor known as hydatid-fremitus. A hydatid cyst may attain much greater magnitude than is ever reached by abscess, and may occupy the greater part of the abdomen. Unlike abscess, hydatid disease, unless the cyst is suppurating, is unattended by pain or constitutional disturbance.

5. *Simple hypertrophy.*—Simple hypertrophy of the liver, resulting from an increase of the size or number of the secreting cells, causes a painless enlargement, having the normal shape of the organ, but attaining at times to twice its normal size.

6. *Fatty degeneration.*—This morbid condition of the liver causes a painless enlargement, not usually very great; with preservation of the normal outline and smooth surface of liver; but with diminished resistance.

7. *Albuminoid degeneration.*—In albuminoid disease the liver preserves its shape; is large; usually has a quite smooth surface; and is hard and resistant to the touch. Enlargement from this cause is sometimes very great, and second only to that which results from malignant disease. The surface in albuminoid disease is sometimes irregular, from co-existence of cirrhosis or syphilitic cicatrices. The spleen is usually enlarged.

8. *Malignant disease.*—In malignant disease the liver is not always enlarged; and in the infiltrated form, the surface may be smooth. Usually, however, especially when the disease is advanced, there is enlargement, with loss of normal shape; and the surface is hard and resistant, and covered with nodules, or large knobs and protuberances. The greatest enlargement—sometimes such as to occupy the greater part of the abdominal cavity, is attained in this disease. Pain, varying in character and intensity, seated in the liver or distal, is also generally present.

9. *Cirrhosis.*—In some cases of cirrhosis the liver may be found enlarged, as in the so-called 'hypertrophous' form. *See* LIVER, Cirrhosis of.

STEPHEN H. WARD.

LIVER, Fatty Disease of.—DEFINITION. A disease attended with painless enlargement and diminished consistence of the liver; due to the presence of a large quantity of fat or oil in the secreting structure; and occurring in connection with phthisis and other wasting diseases, or in persons of luxurious and indolent habits, in whom there is usually an abundant development of fat in the tissues and other organs.

ÆTIOLOGY.—Fatty liver may either be due to degeneration of cell-structure through faulty nutrition, or it may result from infiltration of the cells with fat, transmitted through the portal vessels from without (fatty infiltration.) Fatty degeneration is met with in association with other hepatic diseases, as albuminoid disease and cancer. The fatty liver which results from poisoning by phosphorus would, according to the experiments of Voit and Bauer, appear to be due to degeneration, as the dogs upon which they experimented had been kept without food previously, and were starved during the time phosphorus was administered; showing that the fat could not have come from other parts of the body, or been introduced in food, but must have resulted from the metamorphosis of tissue-material. It is with fatty infiltration that we are more particularly concerned. The fat may come either from within or from without the body. The former case is illustrated when the greater part of the fat of the tissues and organs is absorbed, as in the emaciation of advanced phthisis. Louis, who first established the association of fatty liver with phthisis, found it to exist in about one-third of the cases of this disease, and met with it much more frequently in phthisical females than in males. His observations have been amply confirmed by subsequent observers. Fatty infiltration of the liver also occurs in connection with other wasting diseases, and is not infrequent in patients who have been long bedridden. From a therapeutical point of view, the medical practitioner is more interested in the disease under consideration, when fat is introduced from without the body. The affection of the liver is then associated with development of fat in other organs and in the tissues generally. Persons thus affected are usually given to undue indulgence in eating and drinking; to eating not only too much food, but food rich in oil and fat, and drinking beer, but especially spirits to excess. Want of exercise of mind and body, a heated atmosphere, and general luxurious habits, materially assist in determining the affection. In illustration of this cause may be adduced the oft-cited experiments of Magendie, who induced very fatty livers in dogs by feeding them exclusively on butter; and also in the production of the *foie gras* in geese, by penning them up in a heated atmosphere and cramming them.

Anatomical Characters.—In fatty disease the liver is more or less enlarged, but seldom to any great extent; the surface is smooth; the borders are rounded; the substance pits on pressure; and the organ is either of pale yellow or drab colour, or, when partially affected, has a mottled appearance. A portion placed in water floats, showing a diminished specific gravity. On cutting into the organ, the knife is greased; and a greasy stain is imparted to blotting paper applied to the cut surface. A portion when held in the flame of a lamp or candle, will, when the water is driven off, burn. It is, however, as Frerichs remarks, only by the microscope that the degree to which the liver is implicated can be determined. In slighter grades, fat-granules and globules are seen to be limited to the outer zone of the lobules in the vicinity of the portal vessels; but in advanced cases the whole of the cells will be found to be filled either with separate globules, or with a single large drop of fat. In less extensive infiltration the liver may be marked by red spots, corresponding to the hepatic veins. Fat in limited quantity is always present in the human liver, so that the term fatty can only be applied when it is in excess.

Symptoms.—In the lesser grades of the disease, there are scarcely any distinctive symptoms, either objective or subjective. When the affection is more pronounced, percussion will indicate more or less enlargement, usually in the downward direction; and palpation may detect a rounded border and diminished consistence, and will, at any rate, determine that the organ is not unduly hard, has no irregularity of surface, and does not differ materially in shape from the healthy liver. There is seldom, if ever, any pain; at most, in marked cases, a sense of tension and of uneasiness on lying on the left side. Jaundice is a rare event; and ascites and enlargement of the spleen cannot be classed as symptoms of the disease. In cases of fatty infiltration, dependent on luxurious habits, as regards diet, &c., there is usually more or less development of fat in other organs, as well as in the omentum and subcutaneous cellular tissue. There is also a greasy condition of skin, with peculiar odour, resulting from abnormal oily secretion from the sebaceous follicles. Dr. Addison considered a peculiar condition of the skin—presenting to the eye a bloodless, almost semi-transparent, and waxy appearance, and to the touch a feeling of smoothness, looseness, and flabbiness—as indicative, if not pathognomonic, of fatty degeneration of the liver. In cases where the liver is much enlarged, and there is much abdominal fat, the upward pressure may interfere with the action of the diaphragm, and cause, especially after meals, embarrassment of breathing. The functional symptoms likely to be present in advanced cases are irregularity, generally sluggishness, of the bowels; more or less dyspepsia; and, perhaps, loss of appetite. In some cases a weak or irregular, or intermitting action of the heart, with tendency to faintness or giddiness, points to implication of this organ, and is indicative of possible fatal consequences.

Diagnosis.—The enlargement of the liver, with preservation of its normal shape, without hardness or irregularity; the absence of pain, jaundice, ascites, or enlargement of the spleen; and its association either with the emaciation of phthisis or other wasting diseases, or with the habits of the gourmand and general development of fat in the body, will usually enable us to distinguish fatty from other hepatic enlargements.

Prognosis.—The prognosis of fatty disease of the liver is affected by the associated general condition of the patient, and will, of course, be unfavourable in phthisis.

Treatment.—The general therapeutical indications in fatty liver resulting from luxurious habits of living, point to reform in the direction of diet, air, exercise, &c. Rich, oily, and fatty articles of food are to be avoided; whilst sugar and starch should be taken in moderation. Beer, in all forms, is objectionable, and so also is alcohol, unless well-diluted, and taken only at meals. Champagne is objectionable, but other light French wines are admissible. Exercise, either on foot or horseback, should be had recourse to daily, but must be regulated according to the soundness of the heart and circulation. Free exposure to pure air, and avoidance of heated rooms, are desirable. The functions of the skin must be promoted by adequate clothing, and by the use of the bath, or by sponging with soap and warm water. The bowels must be attended to, and dyspepsia met by antacids and vegetable bitters. The Carlsbad waters—the warm Sprudel especially—are indicated, being supposed to act upon the redundant fat. Stephen H. Ward.

LIVER, Functional Disorders of.—Introductory Remarks.—The late Dr. Copland, in his *Dictionary of Practical Medicine*, arranged these disorders under three heads, according to the nature of the biliary secretion. 1. Diminished secretion of bile; 2. Excessive secretion of bile; and 3. Vitiated biliary secretion. Dr. Budd, whilst recognising the functions of the liver as threefold, namely, as to changes effected in the blood, the formation of sugar, and the secretion of bile, almost restricts what he says upon the subject of functional disorders to abnormal conditions of the secretion—excessive, defective, or unhealthy bile. The late Dr. Murchison, in his lectures on *Functional Derangements of the Liver*, showed that the classification heretofore adopted, does not represent the present state of knowledge of the functions of the organ. He summarises these functions under three heads:—1. The formation of glycogen, which contributes to the maintenance of animal heat, and to the nutrition of the blood and tissues. 2. The destructive metamorphosis of albuminoid matter, and the formation of urea and other nitrogenous products, which are subsequently eliminated by the kidneys; these changes also maintaining the animal heat. 3. The secretion of bile, a large portion of which is reabsorbed, assisting in the assimilation of fat, and other elements; whilst a part, passing downwards, stimulates the peristaltic action of the intestines, and arrests decomposition. The author just cited arranged the phenomena of functional derangements of the liver under nine heads. 1. Abnormal nutrition. 2. Abnormal elimination.

3. Abnormal disintegration. 4. Derangements of the organs of digestion. 5. Derangements of the nervous system. 6. Derangements of the organs of circulation. 7. Derangements of the organs of respiration. 8. Derangements of the urinary organs. 9. Abnormal conditions of the skin. The above heads, however, represent for the most part functional and general symptoms resulting from functional hepatic disorders, rather than these disorders themselves. The arrangement under three heads, representing the three principal functions of the organ, is that which the writer proposes to adopt.

Ætiology.—It is scarcely necessary to remark that functional disorders of the liver are often secondary to structural diseases of the organ, or to diseases of the thoracic and abdominal viscera, febrile affections, malaria, and other causes. It is with the causes which induce these disorders when primary, that we are here concerned. Prominent among such causes are errors in diet, and the undue use of alcoholic liquors. Habitual over-eating, and especially indulgence in rich, fatty articles of food, such as rich soups, entrées, and pastry; and the undue use of sugar, fish or flesh containing much oily matter, are very apt to disturb the function of the liver. Excess in the use of alcoholic drinks is another cause, in this country, in frequent operation. The combination of sugar with alcohol much enhances the mischief. Hot, sweetened grog; sweet new wines, as champagne, unless dry; Madeira, and sweet sherries; port-wine; liqueurs; and malt liquors, particularly mild ales and stout, are ready causes of hepatic derangement. Want of exercise, whether the result of necessity or of indolent habits, is another common exciting cause of hepatic functional disorders; and its effect is enhanced when it is associated with errors in diet. Living habitually in a high temperature, whether in a warm climate or in over-heated rooms, is another cause, and is intensified when associated with the causes already alluded to. Depressing nervous and emotional influences must not be forgotten in considering the ætiology of the subject.

Symptoms.—The phenomena which are observed in functional derangements of the liver may now be briefly indicated, according to the particular hepatic function which is disordered.

1. Disorders of the Glycogenic Function.—Disorders relating to the glycogenic function fall under the subject of diabetes, and need here only be alluded to. *See* Diabetes.

2. Disorders of the Metabolic Function. In reference to derangements from faulty function connected with albuminoid disintegration, &c., the writer quite concurs with, and will concisely state the views advanced by Dr. Murchison. One of the immediate results of such faulty function is the non-conversion of nitrogenous matters into urea, and the production of lithates and lithic acid, inducing a condition of blood to which this authority fitly applied the term *lithæmia*. This lithæmia may be relieved for a time by elimination by the kidneys, showing itself in deposits in the urine, on cooling, of lithic acid, lithates, and pigmentary matter. These deposits are not unfrequent in persons in good health, especially after any excess or error in diet; and they are more or less constant in subjects of gouty habit of body, and in those who are predisposed to hepatic derangement, or who induce it by habitual over-stimulating diet. These deposits may exist for years without causing much discomfort; but after a time, the excessive quantity of lithic acid and lithates cannot be eliminated by the kidneys; and they accumulate, causing disturbances in different parts of the organism, and giving rise to various more or less distressing symptoms. Of these symptoms the more prominent are:—epigastric oppression, flatulent distension of stomach and bowels, heartburn, acid eructations, sense of weariness and tendency to sleep after meals, furred tongue, unpleasant taste in the mouth, especially in the morning, appetite often good, sometimes the contrary, an excessive secretion of viscid mucus in the fauces and back of the nose, constipation and vitiated secretions. Palpitation, irregular or intermitting pulse, frontal headache, vertigo, noises in the ears, restlessness at night, irritability of temper, and hypochondriasis, are other symptoms that are not unfrequently present.

Gout, whether openly expressed, latent, or irregular, is associated with the symptoms just mentioned, and is one of the results of lithæmia, and of faulty hepatic function.

Urinary calculi are another result of lithæmia, at all events, those which consist of lithic acid or its salts, and which are the most frequent. Sir H. Thompson confirms this view, and shows that the formation of these calculi is to be prevented by remedies and a *régime* directed to the liver rather than to the kidneys.

Biliary calculi are also a result of functional hepatic derangement, and are frequently associated with a gouty habit of body, and with lithic acid deposits and calculi.

Lithæmia predisposes to local inflammations. Individuals who are subject to deposits of lithic acid and lithates are more liable than others to severe local inflammations; and in reference to this fact, Dr. Murchison made the practical observation that in such persons the lithates cease to be eliminated on the advent of a local inflammation or ordinary febrile catarrh, to be again discharged freely on the subsidence of the pyrexia. In such cases, he added, the retention of lithates in the system has probably determined the attack.

Some diseases of the skin, as eczema, psoriasis, lichen, and urticaria, are unquestionably often induced and maintained by lithæmia and the hepatic derangement from which it results.

To conclude this portion of the subject, the functional derangement under consideration, as Dr. Murchison remarked, 'by the production of peccant substances which are not readily eliminated, and which, therefore, accumulate in the system, may in the long run lead to many of the most serious maladies, both acute and chronic, to which our race is subject.'

3. Disorders of the Biliary Function.—Disorders referable to faulty biliary secretion may be divided into (*a*) those due to *excessive* secretion; and (*b*) those due to *deficient* secretion. It is scarcely necessary to arrange those due to vitiated bile under a separate head, as the secre-

tion may be vitiated, whether it be redundant or deficient.

(*a*) *Excessive* secretion of bile is characterised by bilious diarrhœa—copious, fluid, bilious evacuations, nausea, or not unfrequently vomiting; twisting, griping pains in the abdomen; and perhaps some febrile symptoms. The bile in some cases seems to be peculiarly acrid, and causes much smarting when it is voided. The urine is generally high-coloured, and loaded with lithates. There is frequently headache, and either irritability of temper or depression of spirits. Disturbances of circulation, in the form of irregularity of pulse, and palpitation of the heart, are also occasionally present. As has been stated under the article LIVER, Hyperæmia of, this excessive secretion of bile, with the attendant symptoms, is usually the result of congestion of the liver.

(*b*) *Deficient* secretion of bile is characterised by dyspeptic symptoms, such as furred tongue, unpleasant taste in the mouth, loss of appetite, and flatulence. The action of the bowels may be irregular, but is usually costive; and the evacuations are of a pale yellow, or drab, or whitish colour, and often of offensive odour. The complexion is usually sallow and anæmic, not often jaundiced. Disturbances of the circulation, in the form of languid or irregular pulse, and of the nervous system, as headache, languor, drowsiness, and hypochondriasis, are frequent concomitants. The urine is generally dark-coloured, turbid, and loaded with lithates. There is also, in cases of long standing, loss of flesh. Indeed, the functions of the bile in promoting the assimilation of fat, in stimulating the peristaltic action of the intestines, and as an antiseptic, are well illustrated in the symptoms which attend protracted deficiency of the secretion.

TREATMENT.—Among the remedies which promote the expulsion, if not the secretion of bile, mercury and its preparations hold a prominent place. For notwithstanding the results of experiments upon animals, few practitioners will be content to give up the advantage which their clinical experience has taught them is to be derived from the judicious use of mercury. It is possible that the drug merely effects the expulsion of the bile; the result, however, is unquestionable. In excessive secretion of bile a single full dose of calomel, followed in a few hours by a saline draught, will cause a free downward discharge; and in the lithæmic condition of system, indicated by turbid urine containing copious lithates, the same treatment will afford ready relief. In smaller doses, repeated at intervals, and combined with other aperients, as colocynth, or rhubarb, mercury will be followed by beneficial results in less active functional derangement. In some cases mercury is inadmissible, or disagrees, and, in any case, it is well not to repeat it too frequently, or to continue it for too long a time, as its protracted use is apt to impair digestion and nutrition, and weaken the function of the organ which it at first relieves. Of late years a valuable addition to the list of cholagogues has been made in podophyllin. A quarter of a grain to a grain of the resin may be given for a dose, combined with a little hyoscyamus or half a grain of extract of cannabis indica to prevent griping, and a grain or two of rhubarb or watery extract of aloes, or, if it is desirable to quicken the action, with some extract of colocynth, or it may be given in solution as a tincture. When the drug acts favourably it produces one or two bulky evacuations, with copious excretion of bile, followed by a feeling on the part of the patient that the bowels have been thoroughly emptied. Its action, however, is at times neither satisfactory nor certain, and it causes occasionally much griping, irritation, and tenesmus, and subsequent depression. Taraxacum is useful as an aperient, and probably alterative, in functional hepatic disorders, and may be given in cases where the gouty or lithic acid diathesis exists, in combination with alkalies, especially the bicarbonate of potash. The fresh extract, in ten to fifteen-grain doses, acts better than the juice. Nitro-muriatic acid is indicated in cases of torpid liver associated with oxaluria (*see* LIVER, Hyperæmia of). The saline aperient draught has of late been in a great degree superseded by one or other of the aperient mineral waters, the Friedrichshall, Pullna, Hunyadi, &c. These should be taken in the morning, fasting, and their effect is quickened by the addition of some warm water. The action of these waters, as of the saline purgative, is to cause a drain from the intestinal vessels, and thus to relieve the congested hepatic portal system. The waters of Carlsbad, Marienbad, and other similar springs contain no sulphate of magnesia, and owe their aperient effect to the sulphate of soda which is the preponderating ingredient. This drug does not act by stimulating intestinal secretion, but, according to Buckheim, by retaining the water in which it is dissolved and that which it meets with in the bowel, and so constituting a solvent which loosens and softens and carries down dried fæcal masses, and tenacious mucus. The amount of carbonate of soda associated with the Glauber's salt in these waters renders them antacid, and assists in determining a diuretic as well as aperient action. The mineral waters, or the salts obtained from them by evaporation, may be taken at home in the morning, in conjunction with sufficient warm water. For those individuals especially who are suffering from hepatic congestion or merely functional disorder, especially if the result of irregular habits in eating and drinking, a visit to and course of waters at one of the spas will, if means permit, be desirable. Change of scene, regularity in diet, and absence from mental harass, are, of course, important elements in the success of a more or less protracted stay at such places; and it is remarkable how readily many individuals, who are quite unmanageable at home, submit to strict hygienic arrangements under fresh influences. Cheltenham, Leamington, and Scarborough in this country, and in addition to those already named, Homburg and Kissengen on the Continent, are amongst the spas which enjoy special renown in the treatment of liver-affections. *See* MINERAL WATERS.

In no class of disorders do general remedial or hygienic agents act more beneficially than in functional derangements of the liver. Pure air,

exercise, strict attention to the functions of the skin, and suitable diet, are the curative means on which we must mainly rely. In all cases it is of moment to promote the healthy action of the skin and lungs. This is to be done by exercise on foot or horseback. The latter is peculiarly advantageous, as it stimulates directly, by a series of succussions, and by contraction of the abdominal muscles, the liver and intestines, and may be had recourse to, in moderation, by those who are not very vigorous. Walking promotes the general circulation, excites the action of the skin, increases the frequency and fulness of the respirations, and indirectly tends materially to relieve a congested or indolent state of liver. The action of the skin must also be maintained by adequate clothing in all seasons of the year, and by daily use of the sponge-bath, followed by active friction of the entire surface of the body.

The diet should be of a light nourishing character; and rich gravies, made dishes, soups, sauces, pastry, raw vegetables, and such articles, should be carefully avoided. The nitrogenous foods suit best, especially where there is associated lithæmia; starchy and saccharine articles being objectionable. The stronger spirituous drinks are to be entirely avoided; but the lighter wines, as claret, hock, and light dry sherry, may be taken at meals in moderation.

S. H. Ward.

LIVER, Gangrene of. *See* Liver, Abscess of; and Inflammation, Acute, of.

LIVER, Hydatid Disease of.— Synon.: Echinococci of Liver.

Anatomical Characters.—The liver is the organ most frequently affected with hydatid disease. There is usually but one cyst, but there may be two, three, or more; and the size of the cyst may vary from that of a pea to that of a child's head. The cysts may exist in either lobe of the liver, but they are more frequent in the right; and they may be attached to the upper or under surface, or project from the border, or lie buried in the substance of the gland. This is more or less modified in form, and increased in size, according to the magnitude and site of the cyst. When the cyst is small and deep-seated, there will be no appreciable change in the liver, and the disease may be latent for years. When, however, the cyst is very large, it, with the liver, may constitute a tumour, which may encroach upon the thorax, and also fill a great part of the abdomen. Pressure of the cyst may induce atrophy of a portion of the liver, but, at times, hypertrophy is the result. The bile-ducts have occasionally been found to be obliterated, or a communication to have been effected between them and the cysts. When at the surface of the organ, the cysts as they enlarge may induce inflammation and thickening of the peritoneum, and adhesion to neighbouring structures.

Symptoms.—A hydatid cyst, when sufficiently large and near the surface, generally exhibits itself as a tumour of variable size, situated either in the right hypochondrium or in the epigastric region; evenly globular in its early stages; firm, resisting, yet elastic, and, at times, with a sensation of fluctuation. Briancon and Piorry noticed a vibration or trembling—hydatid fremitus—which is felt when the surface is compressed gently by three fingers of the left hand, and sharp percussion made with the right hand over the middle finger. Frerichs does not consider this sign of much importance, it having been present in only one-half of his cases. If the tumour is situated behind the liver, it will, as it develops, push this organ forwards, flatten it, and increase the area of dulness. The tumour may last for a considerable time, and go on increasing to some extent, and yet the patient remain free from constitutional disturbance, perform all his functions well, and keep in good condition as regards flesh and strength. When, however, it has attained a very large size, it will give rise to various symptoms; to a feeling of tightness and distension; if it press upwards, to embarrassed breathing, cough, and palpitation; if upon the abdominal viscera, to interference with their functions. Pain is not generally present, but in some cases there is a gnawing pain, either at the epigastrium, or extending forwards from the lumbar region. Œdema of the lower extremities may occur when the tumour presses upon the inferior cava.

Diagnosis.—Hydatid tumour of the liver is not always easily diagnosed; but the characteristic features already noticed, and its compatibility (in many cases up to an advanced stage) with a good state of health, will generally point to its nature. Abscess of the liver will be distinguished by local and remote pain; the frequent antecedence or co-existence of dysentery; and severe constitutional symptoms, such as hectic fever, rigors, &c. It must, however, be remembered that hydatid cysts are liable to become inflamed and to suppurate, when the diagnosis will not be so readily made. Cancer of the liver will generally be marked by irregularity of surface; the presence of pain; the cachectic aspect; and the rapidity of progress. Aneurism of the abdominal aorta may form an epigastric tumour, of even, spherical shape; but the pulsations, frequently very forcible, coupled, probably, with bruit, audible along the course of the vessel before and behind, will determine the diagnosis. The site, the pyriform shape and uniform size, and the usual accompaniment of jaundice, will distinguish from hydatid disease the tumour caused by a distended gall-bladder. Frerichs thinks that hydatid disease of the liver is more frequently confounded with localised pleuritic effusion at the base of the chest than with any other affection. He remarks that the same signs—dulness on percussion, absence of vocal thrill, intercostal fluctuation—would be present in both cases. He rests the diagnosis on the fact that the line of dulness would present a curve which would look upwards in the one case, downwards in the other.

Prognosis and Terminations. — Hydatid tumour of the liver may last for years, and be compatible with an average state of health; or at an early or advanced period of its existence, it may terminate in one of the following ways:— 1. It may, from its bulk and position, press upon and interfere with the functions of different organs. Pressure on the large venous trunks may induce ascites and dropsy of the lower ex-

tremities; pressure upon the stomach and intestinal canal may obstruct functions connected with the assimilation of food, and induce failure of flesh and strength, and ultimately death from exhaustion. 2. The tumour may contract adhesions with the diaphragm; ulcerative action through this may be set up, and either (*a*) discharge of the contents of the sac may take place into the pleura, and fatal pleuritis result; or (*b*) further adhesions and ulceration may effect communication with the lung, pneumonic symptoms ensue, and the contents of the sac, mixed with the products of inflammation, be expectorated. 3. A rare result is adhesion to, and ulceration into the pericardium, with escape of contents, and rapidly fatal results. 4. Adhesion may be effected with some part of the alimentary canal, and the contents of the sac be discharged by vomiting or by stool. 5. Rupture of the sac may be caused by a blow or otherwise; the contents be discharged into the peritoneum; and fatal peritonitis result. 6. The tumour may contract adhesions with the parietes; point externally; and be opened or effect an opening by natural process, inflammation and suppuration having been previously set up in the sac. 7. Budd and Frerichs notice a possible cure from the obliteration of the sac by the formation within it of a putty-like matter, which involves or perhaps results from destruction of the cysts. 8. Communication may be effected between a cyst and one of the bile-ducts, and then the result will usually be fatal, although there are one or two cases recorded of recovery. 9. Similar cysts may be formed in other parts or organs of the body. 10. As a possible rare event may be mentioned communication of the sac with the ascending vena cava, escape of the contents into this, transfer of the contents to the right side of the heart, impaction in the pulmonary artery, and fatal asphyxia.

Treatment.—So long as a hydatid tumour induces no distressing symptoms, and does not affect the functions of any organs, there is no pressing cause for interference. When, however, it is rapidly increasing, is accompanied with pain or distressing distension, and especially if by upward pressure it is causing difficulty of breathing, and other symptoms, it will be well to have recourse to tapping. If there be any doubt about the nature of the tumour, the exploratory needle may be first introduced, and should a clear fluid, free from albumen, escape, the case may be fairly pronounced to be one of hydatid disease. It is now, indeed, considered the best treatment not to wait for urgent symptoms; but when the disease is well developed, the cyst yet perhaps single, and the walls elastic, to let out the contents. This is best and most safely effected by puncturing with a fine trochar or with an aspirator. Certain precautionary measures must, however, be attended to. Prior to tapping, a broad flannel roller should be firmly applied round the abdomen, commencing from below and carrying the bandage up to the tumour, so as to assist in fixing this. It is considered desirable not to quite empty the cyst, as by doing so the chance of air entering the cyst is increased. This result may also be further prevented, and adhesion of the cyst to the parietes promoted, by applying a compress of lint over the wound and fixing it firmly with the remainder of the bandage which has been already partially applied. The patient should be kept quiet in bed for a day or two, and rest should be further ensured by the administration of morphia. The late Dr. Murchison discountenanced the use of chloroform for this operation, as the pain is but trifling, and the chloroform may induce vomiting, which would interfere with the subsequent rest of parts, so desirable to ensure a successful result. It is not necessary to wait for the adhesion of the cyst to the parietes before puncturing, as the use of a fine trochar diminishes the risk of escape of the contents of the sac into the peritoneum; and, moreover, the escape of a certain amount of fluid will not usually induce peritonitis. A large proportion of cases thus treated have been successful. When a hydatid cyst has suppurated, it should be opened with a large trochar or a bistoury, and kept open. Puncture and subsequent injection of the cyst with some stimulating fluid; gradual opening of the cyst by applications of caustic potash, so as to ensure adhesion with the parietes; and a large incision with a view to effective removal of contents, are methods of treatment which have been practised, but cannot be recommended in comparison with simple puncture with a fine trochar. Dr. Hilton Fagge and Mr. Durham treated several cases successfully by acupuncture, and by passing a galvanic current through the contents of the cyst; but it seemed probable that the result was due to the acupuncture, and not to the galvanic influence. Treatment by special medicinal agents, administered internally, has been fairly tried. Of these, common salt and iodide of potassium in large doses may be mentioned. They have, however, proved useless. Stephen H. Ward.

LIVER, Hyperæmia of.—Synon.: Congestion of the Liver.

Definition.—Uniform enlargement of the liver, with preservation of its normal shape; caused by over-distension with blood, the result of mechanical obstruction to the return of blood to the heart, or of direct afflux of blood through the portal vessels; attended with a sense of fulness and oppression in the right hypochondrium and in the epigastric region, a dusky and sometimes jaundiced complexion; and terminating, if not relieved, in organic changes in the hepatic parenchyma.

Ætiology.—Congestion of the liver may be either *active* or *passive*. Niemeyer limits the term 'congestion' to the latter, and applies the term 'fluxion' to the former. *Active hyperæmia*, or congestion, results from—1. Excess in eating and drinking, especially in persons of sedentary and indolent habits. Determination of blood to the liver occurs, to some extent, in the process of digestion in connection with ordinary meals, and if these consist of rich and irritating materials, and are repeated too often, or if the liver is stimulated between meals by the imbibition of spirituous liquors, the hyperæmia may become excessive and continuous. 2. Long exposure to a tropical or sub-tropical temperature will, perhaps, induce hepatic congestion, but

such influence may be long resisted by persons of temperate habits; and it is probable that the association of irregularities in eating and drinking mainly contributes to the result. 3. A chill, after exposure to heat, may induce active hepatic congestion, which, in hot climates, may result in suppurative hepatitis. 4. It may be excited by injuries to the liver—such as contusions or wounds. 5. It occurs in connection with suppressed menstruation, especially in women of full habit of body, and who are approaching the period of 'change of life.' 6. Hyperæmia of the liver with enlargement occurs in connection with typhus fever, the acute exanthemata, puerperal fever, scurvy, &c. It is also a result of prolonged exposure to malaria, with or without attacks of pronounced ague. This influence is the main cause of the enlarged livers with which 'old Indians' return to this country. *Passive hyperæmia*, to which the term *mechanical* is applied by some authors, is due to interference with the return of blood from the liver through the hepatic vein and inferior cava to the heart. Such interference may be due immediately to dilatation of the right heart, with affection of the tricuspid valve; to obstruction to the circulation in the course of the pulmonary arteries, caused by different diseases of the lungs; or farther on, in the line of the circulation, to disease of the mitral or aortic valves. The affections of the lungs which interfere with the pulmonary circulation are either acute, as pneumonia, and then the hepatic hyperæmia may pass off with the disease; or they are chronic, as emphysema, and fibroid disease, and then the hyperæmia will persist. Mechanical congestion of the liver may result from direct obstruction to the flow of blood by the pressure on the vena cava of aneurismal or other tumours. Mere weakness of the heart's action often keeps up a certain amount of passive congestion.

Anatomical Characters.—A hyperæmic liver is increased in size about equally in all directions; its resistance is also increased; its peritoneal investment appears distended and shining. On making an incision blood oozes out freely, and the cut surface is dark red, either uniformly so, or spotted with intervening lighter spaces. In the active form of congestion there is engorgement of the portal vessels at the periphery of the lobules; in the passive or mechanical form, the central vessels of the lobules—the hepatic veins—are engorged. In the latter form, when it is due to a persistent cause, as disease of the mitral valve, and has lasted some time, the cut surface gives the characteristic appearance to which the term *nutmeg-liver* has been applied. The dark centres contrast with the pale circumference of the lobules, the light and dark parts are clearly defined, varying according to the section; the surface gives an appearance which resembles closely that of a cut nutmeg. The central dark spots result from distension of the hepatic veins, and deposition of bile-pigment in the adjacent hepatic cells, which are more or less atrophied by pressure; the lighter spaces correspond to the interlobular veins, the light colour being due, according to most pathologists, to the presence of fat in the cells at the circumference. Dr. Wickham Legg, however, states, as the result of an examination of twenty cases of nutmeg-liver, that the fat was not in excess in the majority of them. In addition to the atrophy of the cells by pressure of dilated hepatic veins, there is hypertrophy of the interlobular hepatic tissue, with lymphoid bodies scattered through it and, in later stages, through the liver generally, and it is on this latter cause, as in cirrhosis, that the shrinking of the liver in advanced cases depends. The term 'red atrophy' has been applied to this advanced stage of nutmeg-liver, but, as Dr. Legg remarks, it is objectionable, as having been previously used by Virchow to designate a state of liver met with in wasting diseases, such as typhoid fever. The term 'atrophic nutmeg-liver' answers well. 'Varicose atrophy,' used by some writers, is based upon the dilated condition of the central vessels and their radicles.

Symptoms and Sequelæ.—In slight cases of hyperæmia the liver does not extend much beyond its normal limits, but it may perhaps be felt below the borders of the ribs and across the epigastrium. In severe cases, and especially in passive hyperæmia from obstructed circulation, the organ often attains a considerable size, and is found, on percussion, to extend upwards into the mammary region, downwards nearly to the umbilicus, and across into the left hypochondrium. Its resistance is generally increased, and, in old-standing cases resulting from malaria and hot climate, it has an amount of hardness which characterises, and probably indicates, albuminoid degeneration. There is often, especially in acute cases, tenderness on pressure. The patients do not exactly speak of pain, but of a sense of oppression and fulness in the right hypochondriac and in the epigastric regions, and of uneasiness from the pressure of clothes, or on lying on the left side. In most acute cases there is marked functional and general disturbance; a furred tongue, nausea, vomiting at times of bile, bilious diarrhœa, sallowness of complexion, or some amount of jaundice. In some cases the bile seems to be peculiarly acrid, and causes much griping and distress as it passes downwards, and smarting as it is voided. The urine is high-coloured, and loaded with lithates. The patients often complain of headache, are irritable, depressed in spirits, and feel languid and drowsy. Disturbances of circulation are indicated, in severe attacks, by irregularity of the pulse, and palpitation of the heart. When jaundice, in any marked degree, is present, there is probably catarrh of the bile-ducts, and transient obstruction of these ducts, and then the evacuations are devoid of bile. The hyperæmic condition of liver induced in India or other tropical regions, as the result of high temperature and malarious influence, may terminate in chronic enlargement, and possibly in damaged structure of the organ. The symptoms which mark this are cachexia and anæmia, with sallowness of complexion; a weak circulation, indicated by great susceptibility to changes of temperature, by chilliness and coldness of the lower extremities; disturbances of nervous system, shown by irritability, depression of spirits, disinclination for effort of any kind, headache, giddiness; and other symptoms. Dyspeptic symptoms are

present. The bowels are either constipated or relaxed; the stools in either case showing a deficient or vitiated secretion of bile. The urine sometimes contains bile, frequently oxalate of lime, and excess of urea. The skin is dry and harsh. Individuals with such a condition of liver may prolong their existence for years; or the serious interference with nutrition may induce increasing loss of flesh and strength, and premature death.

In the mechanical form of hyperæmia there are, in addition to special gastric and hepatic symptoms, other symptoms indicative of the pulmonary or cardiac affection on which it depends. The complexion is more or less dusky, and there is a certain amount of lividity mixed with the jaundiced hue. The liver, which may have become much enlarged, will, if observed carefully in any protracted case, often be found again to diminish as the atrophic change takes place. Ascites may now become a prominent symptom, whilst, as Niemeyer remarks, the general dropsy resulting from associated heart-affection may be yielding to treatment.

Diagnosis.—Hyperæmia of the liver, when it is the result of obstruction to the circulation caused by diseases in the chest, is easily recognised. Also, when of the active kind and acute, it is not likely to be mistaken for any other cause of enlargement. It is only when the congestion is chronic, and the liver hard and resistant, that an erroneous diagnosis may be made, but the previous history of the case, and associated general symptoms, will lead to a right conclusion. It might be mistaken for albuminoid disease, but then it may be really undergoing this degeneration.

Prognosis.—Active hyperæmia of the liver usually ends favourably on removal of the exciting cause, and under appropriate treatment. The following considerations will, however, influence the prognosis. 1. An attack of hyperæmia in an individual of intemperate habits may be but the early stage of cirrhosis. 2. A similar attack, occurring in India, may, as Dr. Maclean remarks, be but the commencement of acute hepatitis, which may end in suppuration. 3. The prognosis in the mechanical congestion, dependent upon disease in the chest, will be influenced by the nature and stage of such disease.

Treatment.—An attack of acute hyperæmia of the liver will usually be relieved quickly by rest; by restriction to a bland, fluid diet; and by ensuring free action of the bowels by a dose of calomel, followed after a few hours by a saline aperient, either in the form of a draught, or of one of the more active mineral waters. A single sufficient dose of calomel, four or five grains, will often rapidly relieve attendant gastric irritation and vomiting, and ensure a free downward discharge of bile. Should there be much tenderness on pressure over the liver, the application of sinapisms or turpentine stupes, followed by hot poultices, will be beneficial. So long as any acute symptoms continue, the patient should be kept quiet in bed; the diet should be light and fluid; and stimulants should be rigorously excluded. The portal system must be kept relieved by a dose of Pullna or Friedrichshall water, or a saline draught, every or every other morning, preceded the previous night by some mercurial preparation, if the secretion seem to require this. Podophyllin may be advantageously substituted for mercury, in some cases, but it is uncertain in its action. Its griping effect is counteracted by the addition of a little extract of hyoscyamus or half a grain of extract of cannabis indica, and its action will be quickened by adding a little compound colocynth pill. When the acute stage of hyperæmia is passed, taraxacum often acts well as a purgative and alterative; combined, in subjects of gouty habit, whose urine is more or less charged with lithates, with bicarbonate of potash, or, in other cases, with nitro-muriatic acid. This acid, in torpidity and chronic enlargement of the liver, is one of our most effective remedies. It acts by altering and promoting the biliary secretion, and by improving the tone of the digestive organs. In the chronic enlargement of liver of 'old Indians,' and in that which results from malarious poison, and also in other forms of chronic congestion, it often acts very beneficially. It may be used both internally and externally. Ten to twenty drops of the dilute acid of the pharmacopœia may be given two or three times daily, combined with taraxacum, quinine, or other drug, according to indications. The external use of the acid has been advantageously had recourse to at the Seamen's Hospital for years, either in the form of compress over the abdomen, or by sponging the surface of the body, or by the use of baths to the lower extremities. The fluid for the bath or compress is prepared by adding eight ounces of the dilute acid of the pharmacopœia to a gallon of water of about 98° Fahr. The compress may be applied by soaking a flannel roller of sufficient length, about a foot in width, in the prepared acid, and wringing it so that it merely remains damp. The roller should be then applied round the body, covered with a piece of oiled silk, and worn constantly—subject, however, to renewal of acid night and morning; or the lower extremities may be immersed in the fluid for about twenty minutes, night and morning, and the inner sides of the thighs and the body be sponged at the same time. Earthenware or wooden baths should be used; and the sponges and towels after each bath must be well washed in cold water, or they will be destroyed by the acid. At times the external use of the acid causes purging; and in several cases, at the Seamen's Hospital, severe irritation of the skin, with copious papular eruption, resulted, and the remedy had to be discontinued.

Chloride of ammonium and iodide of potassium must be mentioned as drugs that have been found serviceable in reducing livers enlarged by chronic congestion. In the hyperæmia resulting from disease of the mitral or aortic valves, or from chronic lung-changes, it is sufficient to remark that the chest-symptoms will often be most effectually relieved by treatment directed especially to the liver.

Much benefit will result in many cases of hyperæmia by a course of mineral waters at one of the German or English spas. Marienbad, the cool springs of Carlsbad, rather than the Sprudel, Kissingen, Cheltenham, Harrogate, &c., are indicated in active hyperæmia; the more tonic

waters in the more chronic forms of congestion. A more detailed notice of the different spas and waters in relation to liver-affections is given at the end of the article on Functional Disorders of the Liver. *See* MINERAL WATERS.

STEPHEN H. WARD.

LIVER, Hypertrophy of.—In true hypertrophy of the liver, the increase in the size of the organ is due to enlargement and multiplication of the secreting cells, without any morbid change having taken place in these, and without the deposit around them of any morbid material. The parenchyma of an hypertrophied liver is generally firm and vascular, in some few instances pale and flabby. The hypertrophy may be *partial* or *general*. *Partial* hypertrophy may either result from localised irritation of the liver, as in tight-lacing; or it may compensate for some other portion of the organ reduced or entirely destroyed by disease, as in the large irregular lobules of hepatic tissue formed in advanced cases of syphilitic hepatitis. *General* hypertrophy has been found in some cases of diabetes mellitus; in leukæmia; and, according to Dr. Jules Simon, in a certain cachectic condition produced under the combined influences of deprivation, scrofula, and residence in a damp locality. Whether true hepatic hypertrophy can be caused by residence in hot climates, or by prolonged exposure to malaria, seems, according to Frerichs, to be open to doubt. It is probably due in some instances to prolonged congestion of the liver, and as a result of such a condition may occasionally be met with in drinkers and free livers, and in the subjects of pulmonary and cardiac diseases. W. JOHNSON SMITH.

LIVER, Induration of.—The liver is commonly hardened whenever it is small. Simple induration is a state in which new connective-tissue seems to replace the proper hepatic tissue throughout large tracts of the liver. Often the organ becomes small and lobulated; at other times it is increased in size, and a case has been known in which it weighed eight pounds, constituting a connective-tissue hypertrophy of the liver. The diseased part presents the appearance of a completely homogeneous, whitish-yellow, firm, hard mass; which under the microscope is seen to be made up of connective-tissue, in which no, or very few, elements of liver-substance can be made out.

J. WICKHAM LEGG.

LIVER, Inflammation of, Acute.—SYNON.: Acute Hepatitis; Fr. *Hépatite aiguë*; Ger. *Acute Leberentzündung*.

It is usual to divide acute inflammation of the liver into *perihepatitis*, involving the investing membrane of the liver and Glisson's capsule; and *hepatitis*, in which the parenchyma of the liver is engaged—in other words, into superficial and deep-seated; but, practically speaking, perihepatitis is rarely more than an accompaniment of hepatitis, of peritonitis, or of an acute attack of a neighbouring organ. We shall not treat of the two separately, as they are constantly associated with each other.

ÆTIOLOGY.—Acute hepatitis is by no means a common affection in Europe, and even in the tropics congestion is far more frequent than acute inflammation. The chief causes of hepatitis are exposure to heat, and to changes of temperature—both of which have a large share in what is called tropical influence—irregular habits of life, and spirit-drinking. Irregular action of the liver and of the bowels predisposes to it. Men in the tropics are far more subject to the disease than women or children—in fact acute hepatitis is exceedingly rare in children. The disease is uncommon in men under the age of twenty, and appears to be most frequent between the ages of twenty-five and thirty-five. Independently of the cases in which it appears to be connected with dysentery, many authors believe hepatitis to be induced by the same causes as those which produce tropical dysentery and tropical fever—in other words, by malarious influences. Hepatitis or perihepatitis are sometimes occasioned by falls, or by external violence, which may operate in producing them either directly or secondarily.

ANATOMICAL CHARACTERS.—The liver when inflamed is usually represented as softened and congested, sometimes having a granular appearance. When cut into, more blood flows from it than usual. It is sometimes infiltrated with serous fluid, with lymph, or occasionally with small spots of pus. While portions of the liver are involved in inflammation, other portions may be unaltered; but most generally it is inflamed or congested throughout, in some parts in red patches, while in other parts there are patches of a yellowish colour. These may be traced in their changes until they are converted into abscesses, which may be single, or less frequently multiple; usually these are enclosed in a cyst, which varies from the thinnest half-formed membrane to a tolerably tough one. If there has been much perihepatitis, the liver is very commonly adherent to the diaphragm or to the neighbouring viscera by organised lymph, and its capsule is thickened.

With reference to the distribution of its blood-vessels, it has been presumed that congestion of the liver is mainly caused by obstruction to the hepatic veins, consequent on affections of the heart or lungs, or by some obstruction of the vena portæ, or morbid alteration of the blood which it conveys. In inflammation, again, the capillaries of the hepatic artery are believed to be primarily engorged. But these matters are not very certain. As regards suppurative inflammation, Budd maintains that it is the result of purulent matter taken up from ulcerating surfaces of the bowel, and conveyed to the liver by the vena portæ.

SYMPTOMS.—These vary much in their degree of acuteness. There is frequently in the commencement chilliness, or even some shivering, followed by fever. The appetite is impaired, and there may be loathing of food. The tongue is white, and usually has a thick white coat. The bowels are sometimes constipated; more frequently there is diarrhœa. Sometimes there is great thirst, along with irritability of the stomach, with bilious vomiting. A certain degree of jaundice has been often set down as a symptom of hepatitis, but it is very unusual. There is frequently pain in the right shoulder, but by no means always. There is often a short,

dry cough. There is generally some fever; the pulse is usually from 100 to 110, and the temperature of the body is increased two or three degrees; but there is seldom present that amount of irritation which one would expect to find, when inflammation is so acute that it may end in suppuration. In the region of the liver the symptoms are various. Sometimes there is sharp lancinating pain, especially when the convex surface is most affected; more frequently there is a dull, heavy pain, which is increased when the patient endeavours to lie on his left side. There is generally pain in the liver on pressure. On careful examination the viscus will often be found to be increased in bulk, but by no means always so. It may be enlarged upwards and backwards, or below the edge of the ribs, or towards the epigastrium. If the inflammation is at all acute, or if there be perihepatitis, which may involve the lower surface of the diaphragm, there may be shortness of breathing, which is often very distressing. The acuteness of suffering depends very much on whether the surface or the deeper portion of the organ is most involved in the inflammation. The urine is commonly high-coloured, and contains an excess of bile-pigment. Sometimes albumin is present, but on the whole nothing very definite is known on this point.

As regards the duration of the symptoms, if there only be perihepatitis, they will probably subside in three or four days. Deep-seated hepatitis may end in about ten days in resolution, or in the formation of abscess (*see* LIVER, Abscess of); or the disease may be protracted in a less acute form for weeks or months, producing enlargement or partial induration of the liver. In such cases, and indeed in the less acute form of hepatitis, it is often difficult to draw a distinction between chronic congestion and chronic inflammation.

DIAGNOSIS.—Hepatitis is not very likely to be confounded with other affections. If the surface is particularly involved, when there is much shortness of breath, and the pains are lancinating, it may be confounded with local pleurisy or pneumonia. The auscultatory sounds, as also the position of the patient, will show whether the lungs are affected—for with pneumonia, with intercostal neuralgia, with inflammation of the stomach, or with the passage of gall-stones, he will not lie on the affected side, as in hepatitis; nor is there in these diseases the excessive irritability of stomach that there is in inflammation of the liver. The pain of gall-stones comes on more suddenly, is more acute, and disappears more rapidly. Sometimes hepatitis has been confounded with enlargement of the gall-bladder, but usually the pyriform shape and prominence of that organ when over-filled should be enough to distinguish it. As for the diagnosis between hepatitis and perihepatitis, it is chiefly of importance as regards the prognosis. The pain in the latter is usually more acute, less of a dull pain, and is less persistent. The parenchyma of the viscus is less sensitive than its surface, as has appeared to the writer, on handling and cutting off two or three inches of liver which had protruded through a wound.

PROGNOSIS. — The prognosis of hepatitis is grave, but its termination is generally favourable in temperate climates, especially when the case is one rather of perihepatitis than of hepatitis. In the tropics the disease is much more formidable. There is always the risk of its running into abscess; or, if that be avoided, of a state of chronic hyperæmia of the organ, with enlargement and constant tendency to relapse supervening. The complication with dysentery or chronic diarrhœa is frequent and unfavourable. The ratio of mortality differs much in different places, and in the same place in different seasons; and it is difficult to ascertain the absolute mortality of hepatitis, as long as congestion and inflammation of the liver are not distinguished in statistical returns. However, hepatitis (if cholera be excluded) has long been, and continues to be steadily, the greatest source of mortality among our soldiers in India. The French found it a very fatal disease in Algiers, and it has always been one of the most serious diseases of hot countries.

TREATMENT.—The activity of treatment must be regulated by the acuteness of the case, and by the presence or absence of complications, such as dysentery. In former days repeated venesection used to be employed. We now find leeches applied over the liver or to the anus at least as effectual. Emollient cataplasms are to be kept constantly applied to the side. The bowels should be freely acted on with the neutral salts. The action of ipecacuanha in large doses is very useful, whether it produces nausea or operates on the bowels. It is particularly indicated where there is dysenteric complication. The general feeling is that the induction of vomiting operates unfavourably, but in the early stage of the disease we do not think a certain amount of it injurious. It seems to relieve the liver to some extent. Calomel and opium, and the exhibition of calomel in small doses, to touch the gums, was the old treatment in India; while the French trusted mainly to the exhibition of calomel, ipecacuanha, and opium. Both modes of treatment were believed to yield satisfactory results. The popular idea that if the patient was once salivated he was secure from the formation of abscess had no foundation in fact. If there is much general fever, the use of an ordinary diaphoretic mixture, with a larger proportion of tartar emetic, will be found useful; if nausea is produced, so much the better. When the symptoms become less acute, the steady use of moderate saline aperients, or of iodide of potassium—in short, the ordinary treatment for congested liver, should be adopted. Counter-irritants and blistering, or the application of tincture of iodine over the liver, are of more use in this than in the earlier stages. The nitro-muriatic acid bath has long been a popular remedy in the chronic stage of hepatitis. The body may be immersed, but a bath for the feet, or sponging the side with a solution of the acid, will usually be found as efficacious. The internal use of the mineral acids the writer believes to be more effective. Change of climate exercises a singularly beneficial effect; especially that obtained by a sea-voyage. Sudden exposure to cold, however, after a return from a warm climate, must be particularly guarded against.

The treatment of the sequelæ of hepatitis becomes practically that of congestion of the liver. The steady use of saline aperients, or a resort to the saline-alkaline, or to alkaline baths, as Carlsbad, Marienbad, Elster, Vichy and others, will be found beneficial. In the acute stage the diet must be low, and limited chiefly to fluids. Great attention must be paid to diet during convalescence also; attention to this will help materially in preventing the disease from becoming chronic; and, indeed, there is no better prophylactic against hepatitis than a carefully regulated diet, with abstinence from spirituous drinks. J. Macpherson.

LIVER, Inflammation of, Chronic.—This is usually only another name for cirrhosis. Sometimes the name is given to a perihepatitis, a thickening and opacity of the capsule enclosing the liver, and beneath which the liver-substance is found hardened and tough, due to an overgrowth of the connective tissue from the capsule. Most pathologists, however, look upon cirrhosis as a chronic inflammation of the liver, and the name is usually restricted to this state. *See* Liver, Cirrhosis of. J. Wickham Legg.

LIVER, Malformations of.—Abnormalities in the form of the liver are not common, and are more often acquired than congenital. The following are some of the most frequently observed malformations that are *congenital*, and due to some original defect:—A more or less quadrangular liver; a rounded liver; reduced proportions or total absence of left lobe; prolongation of the left lobe in the form of a narrow tongue-like process towards the region of the spleen; abnormal grooving of the surfaces of the liver; extreme depth of normal fissures. Another occasional variety of hepatic malformation consists in extensive lobulation, and the existence of one or more additional small lobes—a condition met with in the livers of rodent animals. An extreme instance of this extensive lobulation was observed by Dr. Dickinson, and is recorded in the *Transactions of the Pathological Society* (vol. xvii., p. 160). Acquired malformation may be due to hepatic abscess; to hydatids of the liver; to new-growths; to some form of chronic inflammation (cirrhosis, syphilitic disease); or, finally, to compression of the organ by tight-lacing and other means.

W. Johnson Smith.

LIVER, Malignant Disease of.—Definition.—Development in the liver of cancerous or sarcomatous growths, either primary, or secondary to similar growths elsewhere; causing, generally, enlargement of the organ, with irregularity of its surface; attended with pain, often with jaundice and ascites, with marked cachexia and progressive emaciation; and having usually a rapidly fatal termination.

Ætiology.—Sex has no influence in the causation of hepatic cancer; the disease occurs as often in males as in females. It is very rare in early life, but cases are recorded. Of eighty-three cases analysed by Frerichs, forty-one were between forty and sixty years of age, and the remainder in nearly equal proportions above and below that period. Climate, habits of life, over-indulgence in the use of spirituous liquors, do not seem to play any part in determining the malady. The influence of hereditary tendency to cancer must not, however, be overlooked.

Anatomical Characters.—The malignant growths which affect the liver are usually the carcinomata—the true cancers; and of these, in nearly all cases, the schirrous and medullary or encephaloid forms; the colloid being rarely met with, and then only as a secondary deposit. Of the sarcomata, the melanotic and round-celled or medullary sarcomata are met with occasionally. Cancer may occur as an infiltration of the liver-tissue, when large masses of the liver are uniformly affected, and little or no irregularity of surface results. It usually, however, occurs in circumscribed masses, smaller nodules or larger protuberances, varying in size, to use a familiar comparison, from that of a pea to that of a child's head. These masses are more or less numerous, and usually distinct; or they may encroach upon one another, and give an appearance of coalescence. When near the surface, they give rise to the marked irregularity which is very characteristic of the disease; and when large and numerous, cause considerable increase in the size of the liver. The masses on the surface are sometimes flattened, and have a central depression which has been designated as 'cancer navel.' The growths may be firm and of brawny or even cartilaginous consistence, as when scirrhus prevails; or they may be of medullary softness, when an incision will yield freely the so-called cancer-juice. The cut surface is either white, or reddish-white, or darker red when blood has been recently extravasated, or of varying colour, from altered blood-pigment, when the extravasation of blood has been of longer date. The portal and hepatic veins are sometimes invaded by the cancer, and a clot is formed in them, which becomes cancerous. Colloid cancer of the liver occurs rarely as a secondary invasion from the stomach or peritoneum. Melanotic sarcoma or melanosis exists occasionally in conjunction with the disease in other parts of the body. Malignant disease of the liver is primary in about one-fourth of all cases; secondary in the remainder; and in about one-half of the cases in which it is so, the primary disease has been seated in structures connected with the portal system.

Symptoms.—In the earlier stage of this disease, the symptoms may be merely subjective, and then diagnosis will be difficult. When the disease, however, is far advanced, a prominent irregular swelling may be seen, raising the abdominal parietes, and occupying often a large portion of the abdominal cavity. Lesser grades of the disease may be detected by palpation and percussion. The liver will be found to extend more or less beyond its normal limits; to be hard and resisting; and, in a large proportion of cases, irregular. In a few cases, however, when the disease is infiltrated, the surface will perhaps be smooth throughout. At times there is no enlargement of the organ, and the portion affected lies under the ribs, so that physical examination does not help us. There is often tenderness on pressure, especially when the peritoneal coat is inflamed. Usually, but not always,

there is pain in the liver itself; sometimes merely a feeling of tightness and fulness; at other times a gnawing, aching pain; and some patients have described the pain as 'burning.' There is frequently also pain shooting back to the spine, over the sacrum, or about the angle of the right scapula. A sensation as of a cord drawn round the right hypochondrium has been complained of. There is sometimes pain radiating down to the lower part of the abdomen; and occasionally wandering pains in the extremities and body generally are complained of. When the stomach is intact, there may be no material disturbance of its functions, but usually derangement is manifested by loss of appetite, nausea, vomiting, and other symptoms, which will be intensified if the stomach is implicated in the disease. The bowels are, as a rule, constipated in the earlier stage, but towards the close there is often dysenteric diarrhœa. Jaundice occurs in nearly one-half of the cases of malignant disease of the liver, and is due to compression of the bile-ducts by cancerous masses within the organ, or by an enlarged lymphatic gland in the portal fissure. When once established it is permanent, and the colour of the patient varies, being pale yellow, or deep olive-yellow, or greenish, or sometimes of the dark hue which has given rise to the term 'black jaundice.' The stools in such cases are white or clayey in appearance; and the urine deep-coloured from bile-pigment. The condition of urine, when there is no jaundice, is variable; in the earlier stages of the disease it is generally scanty and pigmented, and loaded with lithates; in the last stage, according to Dr. Parkes, copious, pale, and deficient in urea. This condition he attributes to the utter failure of digestive and nutritive power. Ascites is present in more than half of the cases, and is due either to compression of the portal vessels, or to inflammation of the peritoneum. Sometimes the large size of the tumour, especially if ascites to any extent be present, may cause much pressure upwards, and give rise to distressing chest-symptoms, such as embarrassed breathing, or palpitation. Hæmorrhage not unfrequently occurs in advanced cases. The blood may come from the stomach or bowels, and be due to portal obstruction; or may be of passive character, as in scurvy or purpura; and the bleeding may take place beneath the skin, or come from the stomach or bowels. In the latter case the hæmorrhage is accompanied, according to Frerichs' experience, by intense jaundice, and usually by somnolence and delirium. The complexion of patients suffering from the disease under consideration, when there is no jaundice, is usually sallow, anæmic, earth-coloured. There is, in a large majority of cases, progressive, and towards the close, often extreme emaciation. Generally there is no fever, but a sort of hectic may occur when the cancerous development goes on rapidly, and involves several organs. When the disease of the liver is secondary to, and complicated with cancerous affections of other organs, as the stomach—which occurs in a considerable proportion of cases—pancreas, uterus, or mammary gland, symptoms will exist indicating such complications, but need not be specially dealt with here.

Diagnosis.—When hepatic cancer is somewhat advanced, and the liver large and irregular on its surface, the diagnosis will be easily effected. In the early stage, on the contrary, and in cases in which, throughout, the liver is not perceptibly enlarged, one must be cautious in giving a hasty or too decided opinion. Inherited tendency to cancer; the age of the patient; in women the period of 'change of life;' a sallow, earthy aspect; progressive emaciation; and pain in the right hypochondrium, point with fair probability to the disease. But nearly the same conditions and symptoms may be associated with aggravated hypochondriasis, or chronic tendency to gall-stones; and in the latter case, the difficulty of diagnosis is increased, as gall-stones are often associated with cancer. Permanent closure of the bile-duct from other causes gives rise to persistent jaundice and other symptoms, as in the case of closure by pressure from a cancerous mass. Enlargement of the liver from malignant disease may be confounded with the following hepatic enlargements and malignant tumours:—1. Albuminoid or lardaceous disease. In this affection the hard, perfectly smooth surface, with preservation of normal shape of the liver, absence of pain in the tumour, and of jaundice, will be sufficiently distinctive, unless the liver is rendered somewhat uneven by other associated affections. 2. In a not very advanced stage of cirrhosis, as also of malignant disease, the liver may be enlarged, and its surface uneven, and in both diseases there is great resemblance in the aspect and general cachectic state of the patient, and similar disturbance of gastric and hepatic function. In cancer, however, the ascites is generally but slight, and the liver, instead of contracting, as it usually does in cirrhosis as the disease progresses, continues to increase, and is marked by large nodules and protuberances, which contrast with the smaller elevations in cirrhosis. In cancer the skin is often perspiring; in cirrhosis it is harsh and dry. Intemperance is not an element in the ætiology of cancer, as it is in cirrhosis. In the latter disease, as also in lardaceous liver, the spleen is frequently enlarged. 3. Hydatid tumour is to be distinguished from a localised cancerous mass by the presence of more or less distinct fluctuation; and the absence of pain, and of serious functional and constitutional symptoms. 4. A tumour caused by hepatic abscess would probably give evidence of fluctuation; be associated with or consecutive upon dysentery; and often attended by rigors, hectic fever, and characteristic shoulder-tip pain. 5. Malformations and malpositions of the liver have been mistaken for cancerous enlargement, especially in females about the period of 'change of life.' 6. A highly-distended gall-bladder has been mistaken for a cancerous projection from the liver; but the smooth, oval swelling, and the site of the enlargement, are distinctive, and, as Frerichs says, a practitioner who made an erroneous diagnosis in such case would be wanting in the *tactus eruditus*. 7. Cancer of the omentum would present a movable tumour, separable, probably, from the liver by a slight area of tympanitic resonance. 8. Cancerous deposits in the left lobe of the liver may be readily mistaken for cancerous affections of the stomach. The following points will assist in diagnosis:—

(*a*) Percussion in the greatest thickening of the stomach-walls gives a tolerably clear, tympanitic sound; in cancer of the left lobe of the liver, the sound is much more deadened, and is only somewhat tympanitic on stronger percussion stroke; (*b*) careful examination of the liver, and of the stomach, when full and when empty, will also lead to a correct conclusion; (*c*) even when the liver and stomach are both affected, careful examination may often make out the boundaries of disease in each. 9. Malignant tumour of the right lobe may be mistaken for malignant enlargement of the right kidney. Percussion will generally give a tympanitic sound, from the presence of intestine between the kidney and liver. The hepatic tumour is also distinguished from this and other abdominal tumours by its following the movements of the diaphragm in respiration. But when the renal enlargement is very great, diagnosis is not easy. Three or four years ago a sailor was brought into the Seamen's Hospital with an immense tumour occupying the greater part of the abdomen. This was diagnosed by all who saw it as malignant disease of the liver. After death, however, it was found that the liver was quite healthy, much compressed and narrowed, and spread out over the upper part of an enormous, cancerous kidney. 10. Malignant disease of the ascending or transverse colon will constitute a movable, and generally somewhat tympanitic swelling; and fæcal accumulations in the colon may be removed, but not always readily, by aperients and injections. Percussion, too, will often elicit a resonant space between the enlarged intestine and the liver.

Prognosis.—The prognosis is always unfavourable. The disease when once fully pronounced runs its course rapidly, the fatal termination being seldom deferred beyond a year. Schirrus has usually a longer duration than medullary cancer.

Treatment.—This can be but palliative, and directed to rendering the inevitably fatal course as smooth as possible, by relieving distressing symptoms. Remedies which in other hepatic affections are valuable, such as cholagogues, or mineral waters, are here useless, if not worse. The diet should be plain and nourishing; and the moderate use of wine and alcohol is not contra-indicated, as in other disorders of the liver. Serious gastric and other derangements must be met by appropriate remedies; it being always borne in mind that we have to soothe the patient, and not add to his distress by the exhibition of nauseous drugs. For the relief of pain, the various preparations of opium are indicated, and, as a rule, morphia acts the best. It may be administered either internally, or by the hypodermic method, and must be repeated when pain demands it. Local applications over the liver, as poultices, spongio-piline, &c., with solution of opium sprinkled over the surface, are useful, especially when the peritoneal coat is inflamed. Tapping should not be had recourse to for the relief of ascites, unless this becomes so great as to interfere by upward pressure with the functions of the lungs or heart. The fluid soon reaccumulates, and the effect of the operation is to hasten the fatal termination.

Stephen H. Ward.

LIVER, Malpositions of.—Abnormalities in the position of the liver are much less rare than abnormalities in its form. The more frequent forms of *congenital* displacement are these: Lateral transposition, the liver being found on the left instead of the right side of the abdomen; eventration, the organ being exposed in front of the abdomen of a fœtus; the presence of more or less of the liver in the chest, through congenital deficiency of the diaphragm. In *acquired* displacement the liver may be either depressed or elevated, some rotation of the organ on its transverse axis taking place in an opposite direction in each case. Depression may be caused by pressure from above, as by effusion in the right pleural cavity, and probably to some slight extent by considerable pericardial effusion, or cardiac hypertrophy. Elevation of the liver, which takes place more frequently, may be due to pregnancy, ascites, or the presence of some large abdominal tumour. Curvature of the spine, whether lateral or angular, usually gives rise to some change in the position of the liver. In Potts' disease the organ is often forced downwards towards the crest of the right ilium.

By tight-lacing both the position and the form of the liver may be altered. The organ may be forced downwards, and at the same time so twisted on its transverse axis that its convex surface looks directly forwards, and its concave surface directly backwards. When tightly compressed the upper surface of the right lobe becomes marked by the ribs, and presents transverse puckerings. At the same time the right lobe is bent upon itself, the concavity of its lower surface being much increased. The hepatic tissue corresponding to the summit of the arch thus formed gradually wastes, until at last the lobe is divided into two portions by a deep transverse groove, which portions are connected merely by a membranous band, composed of thickened serous membrane, and the corresponding portion of the hepatic capsule.

W. Johnson Smith.

LIVER, Morbid Growths of.—Several morbid growths have been met with in the liver, of which the following are the most important:—

1. **Simple Cysts.** — These formations are not often met with in the liver. There may be a single cyst, which is usually large; or a number of small cysts scattered throughout the organ. In the latter case the condition is analogous to that of the so-called cystic disease of the kidney, and indeed is sometimes associated with this affection. The cyst-wall consists of a fibrous membrane projecting in folds into the cavity of the sac, and lined on its inner surface by pavement-epithelium. The cyst almost always contains thin clear fluid, and is not connected with any bile-duct or vessel.

2. **Dermoid Cysts.**—Mr. Hulke has recorded an instance in which several dermoid cysts in a withered condition were found attached to the surface of the liver.

3. **Erectile Tumours.**—An hepatic erectile or cavernous tumour consists of a small red or bluish-red formation, of a more or less globular shape, of reticulated structure, and containing

fluid blood or soft coagula. Growths of this nature are often multiple, and each of about the size of a filbert; they are usually found either along the anterior margin of the liver, or on the upper surface of the organ, near the attachment of the suspensory ligament. Each tumour is enclosed in a capsule of delicate connective-tissue. Though seated at the periphery of the liver, an erectile tumour seldom projects beyond the surface of the organ. Much remains to be made out as to the pathological significance of these tumours, especially with regard to their relation to malignant disease. There is some difference of opinion as to their connection with the hepatic vascular system. Virchow and Wilks hold that they are in communication with minute branches of the hepatic artery; whilst Frerichs states that they cannot be injected through this vessel or through the hepatic veins, but only through branches of the portal vein.

4. **Lymphatic Formations.**—The liver is sometimes found studded in all parts with minute patches of tissue of soft consistence, each patch being made up of an aggregation of lymphoid cells disposed in the meshes of a delicate reticulum. These patches of tissue are in close connection with small vessels, from the walls of which, according to Frerichs, they are developed. This condition is associated with leukæmia.

5. **Tubercle.**—Tubercle, as met with in the liver, occurs only in the form of minute miliary granulations, scattered throughout the whole organ, but accumulated more especially on the surface. These growths have been rarely observed in the liver, and in most of the instances in association with acute general tuberculosis.

6. **Cancer.**—Different forms of cancer are liable to affect the liver; but this class of diseases is so important that they require separate consideration. *See* LIVER, Malignant Disease of.

7. **Hydatids.**—This is an important disease affecting the liver, which demands notice in this connection, but it is discussed in a separate article. *See* LIVER, Hydatids of.

8. **Benign Growths.**—Fibrous and other growths have been in rare instances found in the liver, but they do not give rise to any clinical signs. W. JOHNSON SMITH.

LIVER, Nutmeg.—SYNON.: Fr. *Foie noix de muscade*; Ger. *Muscatnussleber.*—Nutmeg-liver consists in a chronic passive congestion of the organ, a state which may always be brought about when there exists any impediment to the circulation of the blood through the heart or lungs. The radicles of the hepatic vein become filled with blood, and thus the centre of each acinus shows a deep red, while the outer parts are either yellow or of natural tint. A nutmeg appearance is thus given to the liver, which is often shrunken and tough, with adherent capsule, and granular surface. Under the microscope the centre of the acinus is seen to be filled with dilated blood-vessels, which, pressing on the liver-cells, cause them to atrophy, so that in advanced stages of the disease they disappear altogether, and the centre of the acinus is made up of blood-vessels only, but there is no increase of the connective tissue in the same situation. The capsule of Glisson now and then takes on an overgrowth, just as in cirrhosis; and the connective tissue between the lobule and around the vessels is considerably increased. It is to this overgrowth of the connective tissue that the shrinking and hardening of the liver are due.

SYMPTOMS.—The liver may sometimes be felt during life under the ribs, more often not. Slight jaundice is often present. The spleen is not enlarged, but is small—the opposite condition to that found in cirrhosis.

TREATMENT.—This must be directed to the condition of the heart or lung upon which the obstruction to the circulation depends. Nutmeg-liver may always be suspected when there exists any impediment to the return of blood from the hepatic veins. J. WICKHAM LEGG.

LIVER, Pigmentation of.—In subjects who have succumbed to intense malarious fever, and in some who during life had suffered from frequent attacks of intermittent or remittent fever in hot climates, the liver may be found to be stained by pigment, either diffused throughout the whole organ, or dispersed here and there in irregular patches. This pigmentation of the liver is always associated with a similar condition of the spleen, and frequently with staining of the nervous centres, the lungs, the kidneys, and the lymph-glands. Hepatic pigmentation is one of the chief post-mortem phenomena of the condition known as 'melanæmia,' in which the blood, especially that of the portal system, is pervaded by granules of pigment of a black or deep-brown colour, some of which are free and isolated, some held together in irregular masses by a pale jelly, and others enclosed in cells. In the pigmented liver these granules are to be found in the portal blood, in the walls of the capillaries, and outside the vessels, scattered amongst the hepatic cells, but not within these cells. In an early stage of the hepatic pigmentation the staining affects only the periphery of each lobule, but, as the disease progresses, the deposit gradually extends to the centre of the lobules, and attacks the hepatic venous system. The arterial capillaries also contain similar pigment-granules.

SYMPTOMS.—The size of the affected liver varies in different cases, and according to the severity and the stage of the disease. The organ is sometimes congested and swollen; it often remains of normal size; in some few instances it finally becomes atrophied. The main symptoms of this condition of the liver are occasional intestinal hæmorrhage, diarrhœa, and ascites. These symptoms in well-marked cases of melanæmia are usually associated with albuminuria, due to pigmentary affection of the kidneys, and with more severe symptoms due to cerebral complications, such as delirium, coma, and paralysis. Melanæmia has been met with mostly in warm climates, and occasionally during severe epidemics of intermittent and remittent fever in some parts of the North of Europe. In this country it has been very rarely observed. *See* BLOOD, Morbid Conditions of.

W. JOHNSON SMITH.

LIVER, Syphilitic Disease of.—The liver

occasionally becomes diseased during the tertiary stage of syphilis, or the period of gummy deposits, the hepatic affection being associated at some period with osseous and cutaneous lesions, and with syphilitic cachexia.

Anatomical Characters.—*Syphilitic hepatitis* may attack both the capsule (*perihepatitis*) and the internal prolongations or septa of the capsule (*parenchymatous hepatitis, syphilitic cirrhosis*). In some cases a small portion, in others a greater part or the whole of the organ, is affected. In the milder form and less advanced stages of the disease the capsule is slightly thickened, and marked by a few isolated white patches, while the surface of the liver is here and there slightly grooved and indented. After prolonged inflammatory action the liver becomes much deformed, and is made up of a number of small lobes bounded by deep depressions, the parenchyma on section being found to be traversed by well-marked bands of tough and retractile connective-tissue. The secretory structures of the liver do not undergo very much change in this disease, and notwithstanding the retractile properties of the fibrous tissue forming the white bands, the vessels and ducts usually remain permeable. The liver-cells occasionally become loaded with fatty elements, and in some rare instances undergo albuminoid degeneration. In cases of syphilitic hepatitis, the liver is almost always bound to the diaphragm, and sometimes to the adjacent viscera, by firm adhesions.

Deposition of *gummy tumours*—'the encysted knotty tumours of the liver,' as they were named by Dr. Budd—occurs more frequently than syphilitic hepatitis, with which condition, however, it is often associated. In this form of syphilitic disease, the liver presents on section, especially in its deeper parts, a number of globular growths, more or less firm in consistence, of a yellowish-white colour, and varying from the size of a pin's head to that of a large walnut. A large deposit of this kind is usually soft or cheesy at its centre, and becomes more and more firm towards its periphery, where it is surrounded by a greyish and translucent zone of incipient connective-tissue, which passes gradually into apparently healthy parenchyma. A full description of the minute structure of these hepatic gummy tumours will be found in a report by Dr. Payne on three specimens shown before the Pathological Society in 1870 (*Transactions of the Pathological Society*, vol. xxi. p. 207). In each tumour it was found that the soft central portion was composed of granular and almost amorphous material, in which were imbedded certain round or irregular translucent bodies of large size, which probably represented collections of degenerated liver-cells. The soft central portion passed imperceptibly into fibro-nucleated structure. The surrounding fibrous zone was found to be composed of dense connective-tissue, in crescentic and irregularly-shaped interspaces, containing masses of fatty globules or granular matter. This fibrous structure was not strictly defined from the structure of the more central parts of the tumour, and on the outside passed into the interstitial connective-tissue of the liver, and became converted into masses of nucleated tissue each of which masses appeared to be formed around a small branch of the portal vein or hepatic artery. Dr. Payne supports the view held by Virchow concerning the pathogenesis of hepatic gummy tumours, and holds that the amorphous central portion is to be regarded, not as a deposit of tissue lowly organised from the first, but as fibrous tissue in a more or less advanced stage of involution and decay.

Whether true *hepatic cirrhosis* may be caused by syphilis is open to doubt, since in most cases supposed to be of syphilitic origin it has been found impossible to exclude with confidence the idea of a probable alcoholic origin.

Albuminoid degeneration of the liver has not unfrequently been observed in the subjects both of acquired and of inherited syphilis, and very often in syphilitic subjects who had not been previously affected with caries or necrosis of bone, with cutaneous ulceration, or with profound or prolonged suppuration. This condition of the liver, when associated with syphilis, is probably due rather to cachexia and debility, than to any essentially syphilitic influences. The almost if not quite obsolete views that the amyloid disease is to be attributed to the action of mercury, or to the combined action of this medicinal agent and syphilis, are opposed by the facts that this condition of the liver has often been observed in a syphilitic fœtus, and also in adults who had not previously been treated with mercury, and never in non-syphilitic subjects of mercurial poisoning.

Symptoms.—The symptoms of syphilitic hepatitis and gummy tumours in the liver are in most instances obscure, so that these complications of advanced syphilis are often overlooked. The liver in some cases is enlarged, in other cases reduced in size. In the former instance it will often be found on abdominal percussion that the relative proportions of the right and left lobes have been much altered, and that there is considerable deformity of the whole organ. Firm globular elevations on the surface of the liver may sometimes be felt through the anterior abdominal wall. Advanced syphilitic hepatitis is usually associated with slight and slowly increasing ascites, and sometimes with œdema of the lower extremities. There is seldom any well-marked jaundice. The patient often complains of a sense of weight and uneasiness in the right hypochondrium, or, in some few cases, of severe pain. In almost all cases there is some hepatic tenderness. The most constant symptoms are of a dyspeptic character; the abdomen often becomes painful and distended; and there is very often, at an advanced stage of the disease, obstinate and profuse diarrhœa.

Diagnosis.—The slow progress of the disease; the absence of any severe pain in the region of the liver; a clear history of syphilis, and the presence of syphilitic lesions at some part of the body; no history of cancer; and the absence of any indications of malignant disease, whether on the surface of the body or in the abdominal cavity, all serve to support the diagnosis of syphilitic, as opposed to cancerous disease of the liver. In ordinary cirrhosis of the liver the progress of the disease is more rapid; the dyspeptic symptoms more severe; the ascites more abundant; and the indications of alcoholism are generally well marked.

TREATMENT.—The treatment of syphilitic disease of the liver is that usually carried out in cases of tertiary syphilis.

W. JOHNSON SMITH.

LIVER, Tubercular Disease of. *See* LIVER, Morbid Growths of.

LIVER-FLUKE.—A common name for the *Fasciola*. *See* DISTOMA.

LLANDRINDOD, in Radnorshire, South Wales. — Saline, sulphated, and chalybeate waters. *See* MINERAL WATERS.

LOBULAR (*lobulus*, a little lobe).—Of or belonging to a lobule. A term generally applied to morbid conditions affecting individual lobules of organs which are thus constituted, such as *lobular pneumonia*, *lobular pulmonary collapse*, and *lobular hepatitis*.

LOCAL.—This term is used in contradistinction to the word *general*. Thus, in connection with *morbid conditions*, it is applied to those which are confined to, or seem specially to affect, a particular part. Again, *local causes* are such as act upon a limited portion only of the body, such as a blow or a burn. *Local treatment* implies the application of remedies in the same sense.

LOCK-JAW.—A popular synonym for tetanus. *See* TETANUS.

LOCOMOTOR ATAXY (*locus*, a place, and *moto*, I move; ἀ, priv. and τάξις, order).—SYNON.: *Tabes dorsalis*; Fr. *Ataxie locomotrice*; Ger. *Graue Degeneration der Hinterstrange des Rückenmarks*.

DEFINITION.—A disease of the spinal cord, characterised by a peculiar unsteadiness in the performance of voluntary movements; or a loss, to a greater or less extent, of the power to control and co-ordinate the action of muscles necessary for the *steady* performance of these movements.

ÆTIOLOGY.—The causes of locomotor ataxy are so various, that in persons who are predisposed to it, almost anything that seriously depresses the nervous power, especially of the spinal cord, will become an exciting cause. Such are cold, wet, excessive fatigue, bad or insufficient diet, depressing emotions of the mind, and, as the writer thinks, onanism, or the long continuance of other forms of sexual excess. Suppression of habitual perspirations, particularly of the feet, and the removal of hæmorrhoids, have in many instances immediately preceded the disease. But prolonged exposure to cold and wet appears to be one of its most common causes. Syphilis is regarded by some as the chief predisposing cause; and the disease is certainly very much more frequent in males than in females.

ANATOMICAL CHARACTERS.—The spinal cord is invariably altered in structure. Generally, the membranes are much congested, and the writer has often found them thickened posteriorly by exudations, and adherent to each other and to the posterior columns. The *posterior* columns, especially in their outer regions, and the nerve-roots are the parts that are chiefly affected. The morbid change consists of atrophy and disintegration of the nerve-fibres, to a variable extent; with hypertrophy of the connective tissue. Oil-globules surround many of the blood-vessels. The posterior nerve-roots undergo the same kind of degeneration, which sometimes extends to the surfaces of the lateral columns, and even along the edges of the anterior. Sometimes the writer has found the extremities of the posterior cornua, and even the central grey substance, more or less damaged by disintegration.[1] The pathological change seems to travel from the centre to the periphery—from the spinal cord to the posterior roots. In the cerebral nerves, however, the morbid change takes an opposite direction—from the periphery towards the centres. Sometimes it extends as far as the corpora geniculata, but seldom as far as the corpora quadrigemina.

SYMPTOMS.—In most cases the unsteadiness begins in the lower extremities; but generally—after a certain but variable time—it involves the upper extremities, the hands and arms being the parts most affected.

As the writer has pointed out, this unsteadiness, or muscular inco-ordination, occurs under two consecutive forms. It first makes its appearance as a simple unsteadiness of gait; the patient walks like a person partially intoxicated. He likewise frequently complains of heaviness in his legs; and of fatigue after walking or after standing. With his legs close together, and his eyes shut, he sways about and would fall if not supported. Later on he finds that he cannot walk without looking at his feet. When the upper extremities become affected, the patient is unable to dress himself, to button his clothes, to write, or to pick up a pin.

After a time a second kind of disorderly movement supervenes. This arises from a spasmodic and jerking action of the muscles, which the will puts in motion, but is unable to control; the patient cannot regulate *the degree of their contraction*. When put in motion the muscles contract beyond the degree intended, and flex or extend the limb with an uncontrollable jerk. All the voluntary movements are hurried and precipitate. The patient seems to be walking upon springs; he proceeds with a kind of prancing gait, and brings his heels to the ground with a kind of kick. If he attempts to take hold of an object he probably will thrust it from him by a spasmodic jerk of his arm. The disease is progressive. At an advanced stage the patient cannot walk or stand without assistance, and even then, if he attempts to advance, he jerks his legs about in the most disorderly manner.

The ataxy or disorderly movement is accompanied by some of the following symptoms, namely:—Strabismus, diplopia, amblyopia, amaurosis, ptosis, contraction of both pupils or only of one; shifting pains in different parts of the body, but chiefly in the extremities; cutaneous and muscular anæsthesia, and loss of the sense of temperature; incontinence of urine, and dysuria; loss of electro-muscular contractility, in a variable degree; abolition of the patellar-tendon reflex; spermatorrhœa, with loss of sexual power and desire; occasionally, but not often, paralysis of the first, fifth, seventh, eight, and ninth cerebral nerves; œdematous swelling of the joints, chiefly of the knees; and cardiac and gastric disturbance.

[1] See *Lancet*, June 10, 1865.

All these symptoms are never found together in any one case of locomotor ataxy, but occur in different groups in different cases, as the following examples will show. The symptoms made their appearance in the order of time in which they are mentioned.

Case 1.—Strabismus and diplopia; pains in the legs, with numbness of toes; ataxy, or unsteadiness of gait; numbness of fingers, followed by pains in the arms, with unsteadiness of muscular movements; incontinence of urine; both pupils contracted to the size of pins'-heads.

Case 2.—Darting and shifting pains in legs, with numbness and heaviness; pains in abdomen and chest; ataxy; pains and numbness in hands and arms, followed by ataxy; analgesia; incontinence of urine, alternating with dysuria; hæmorrhoids; loss of sexual power.

Very frequently the pains in the limbs are, for a variable period, the only precursors of the other symptoms. They are of two kinds—the first is of an aching, gnawing character, and is often mistaken by the patient for rheumatism. The other kinds of pains are acute and lancinating, like electric shocks, shifting from one part of the body to another. They recur in paroxysms, lasting for a few hours or a few days, and suddenly disappear for a variable period.

In other cases the ocular disturbances are the first symptoms that make their appearance. They consist of strabismus, or amblyopia, ending frequently in amaurosis. In a large proportion of cases, paralysis of either the third or the sixth cerebral nerve, with diplopia, is found during the first stage of the disease. The peculiarity of this paralysis is its periodicity. It may last for a few days, or a few weeks or months, and then disappear as suddenly as it came; or it may continue uninterruptedly throughout the disease. Sometimes the strabismus is double, but more frequently it is limited to one eye. Even when there is no perceptible strabismus, there is sometimes double vision, when the patient turns his eyes in a particular direction. Ptosis and dilatation of the pupil are also frequently present. In some cases one pupil is dilated, while the other is contracted. Amblyopia sometimes appears at a very early period, and increases till it terminates in amaurosis.

Cutaneous anæsthesia usually accompanies the ataxy, and affects chiefly the arms, fingers, legs, and toes. The patient says that he seems to be walking on something soft, and does not feel the ground properly; unless he looks at his feet, he scarcely knows that they have reached it. Sometimes he feels as if he were 'walking on air,' on his ankle-joints, or on his hip-joints, when the numbness extends up the legs and thighs. Analgesia, or loss of sensibility to pain, in a greater or less degree, is very common; or painful impressions are felt with unusual slowness. The writer has known cases in which several minutes have elapsed before the prick of a needle has been felt.

Disorders of the urinary organs are generally intermittent in their attacks. Usually the dysuria and incontinence recur alternately in the same stage of the disease. Spermatorrhœa is commonly one of the early symptoms in locomotor ataxy. It is followed by loss of sexual power, with or without loss of sexual desire.

Affection of the joints in locomotor ataxy was first described by M. Charcot, of Paris. The knee-joint is almost always the seat of the disease, which appears suddenly as an elastic œdematous swelling. Like the diplopia, strabismus, and urinary troubles, it may be intermittent—may remain only for a short time, or continue uninterruptedly and result in permanent deformities, with disease of the bones and cartilages of the joint.

The strabismus, amblyopia, and shifting intermittent pains were considered by Duchenne as the first stage of ataxy, which may last for months or years. The next stage is when the ataxy or unsteadiness of gait makes its appearance, either accompanied with or soon followed by anæsthesia or analgesia, generally in the lower extremities. In the third stage many of the symptoms become more marked and more general, the ataxy or muscular inco-ordination extending to the upper extremities. This division into three distinct stages does not, however, apply to all cases.

Diagnosis.—In the early stages of the disease, especially before the muscular ataxy has made its appearance, and when only two or three other symptoms are present, the diagnosis is extremely difficult, even to those who have great practical experience of the disease. Several of the symptoms, such as strabismus, amblyopia, anæsthesia, and the so-called 'rheumatic' pains, which precede frequently for a long time the motor ataxy, may be found in other disorders which differ essentially from this malady. But there is often in some of these symptoms a certain peculiarity which may assist us in the diagnosis. For instance, in a great many cases the strabismus is accompanied by amblyopia; and when it is single, the amblyopia is on the corresponding side. Moreover, the sudden attacks and equally sudden cessation of the pains, their rapid shifting from one place to another, or their remarkable proneness to fix, sometimes for hours, on some particular spot, are not without their significance.

Prognosis and Treatment.—The prognosis is generally very unfavourable. An early diagnosis is of the greatest importance, as it is chiefly at the first invasion of the disease that the patient is most benefited by treatment. An important object is to protect the patient from cold and wet, and keep him in an equable temperature. The whole of the body should therefore be enveloped in flannel. A good and generous diet, with wine or beer, seems best suited for the patient. Of the different medicines that have been used, nitrate of silver seems to have the most specific influence on locomotor ataxy. One-eighth of a grain gradually increased to one grain three times a day, after meals, is the best mode of exhibition. If it should irritate the bowels or the bladder, it may be combined with morphia, cannabis indica, or belladonna. The oxide of silver is a useful substitute for the nitrate, when the latter disagrees. Dry-cupping along the spine has been found useful. For the relief of the severe limb-pains there is nothing so efficacious as the subcutaneous injection of morphia. The writer has

always found that constipation aggravates the pains. Sulphur baths have been used with some relief. Cod-liver oil and phosphorus may also be prescribed. Rest has been strongly recommended; and the constant galvanic current is certainly sometimes beneficial.

J. Lockhart Clarke.

LORDOSIS (λορδὸς, bent).—A term applied to abnormal curvature of the spine forwards. *See* Spine, Diseases of.

LUCID INTERVALS.—No better definition of this state has been given than that of Lord Thurlow, who calls it 'an interval in which the mind having thrown off the disease had recovered its general habit.' It must be regarded as extremely unlikely that a perfect restoration to reason can take place in the course of any long-continued insanity, without full opportunity having been afforded of testing its nature. The law more readily recognises the restoration of the mind to a state of civil capacity such as will render testamentary acts valid, than such temporary recovery as would restore responsibility for crime. If a civil act be rationally performed, the law accepts that as *primâ-facie* proof of the capacity of the agent; but juries very seldom convict the accused of a crime if insanity is proved to have existed within a short period of its commission.

John Sibbald.

LUHATSCHOWITZ, in Moravia.—Muriated alkaline waters. *See* Mineral Waters.

LUMBAGO (*lumbi*, the loins).—Synon.: Fr. *Lumbago*; Ger. *Lendenweh*.—Muscular rheumatism, affecting the muscles and fasciæ of the lumbar region. *See* Rheumatism, Muscular.

LUMBAR ABSCESS.—Definition.—A variety of spinal abscess, usually due to caries of the upper lumbar or lower dorsal vertebræ; in which the pus, instead of taking the course followed in psoas abscess, becomes enveloped by the muscles and fasciæ of the lumbar region, and usually points in this situation; or by infiltrating the cellular interspaces of the abdominal muscles, gains the front of the abdomen, and descends *above* Poupart's ligament. The last-named feature is a diagnostic point of some moment, since psoas abscess, although commencing in the same manner, is usually characterised by making its way *below* Poupart's ligament.

Ætiology.—The origin of lumbar abscess is often ascribed by the patient to a wrench or a blow—statements which must be taken with some caution, since it will be noticed that the patient rarely remembers any injury having happened, until long after well-marked symptoms have arisen. Curvature of the spine is almost invariably present. In children it is almost always the result of scrofulous osteitis; and it has been by some ascribed, in adults, to sexual excesses.

Description.—Lumbar abscess may commence in the soft parts, but when dependent on spinal caries is preceded by the usual symptoms of Potts' disease, which have been coming on slowly and insidiously for a period varying from three to six months.

Owing to the numerous tendinous expansions, and dense aponeurotic structures and fasciæ of the lumbar region, the pus, which has formed in connection with the spine, meets with many obstructions, resulting in singular deflections, before it gains the surface (*see* Lumbar Region). Most frequently it perforates the quadratus lumborum muscle, and points at the edge of the sacro-lumbalis. Here it shows itself as a broad, flat, slightly elevated, fluctuating tumour; having a somewhat irregular surface, owing to the tendinous structures which traverse its cavity. Occasionally the pus of a lumbar abscess makes its way downwards and forwards above Poupart's ligament, or between the abdominal muscles, and points at the outer edge of the rectus abdominis muscle; and indeed there would seem to be no intermuscular or interaponeurotic space which it may not permeate. In other instances, it may be first observed by palpation of the abdominal walls; may simulate cæcal abscess, a malignant growth, an intestinal collection, an aneurysm, or other abdominal tumour; or may burst into the cellular tissue of the abdominal cavity. In children, owing to the relatively small size of the pelvis, there is a chance of the pus mounting over the iliac crest, or sideways over the glutæi muscles.

Prognosis.—The prognosis is precisely the same as that mentioned in the article on psoas abscess. *See* Psoas Abscess.

Treatment.—The treatment is the same as that indicated in psoas abscess, namely, free antiseptic incision. There are, however, cases where spontaneous evacuation of the pus, and treatment by the prone couch have led to good results; and, moreover, there are cases of spontaneous cure.

Edward Bellamy.

LUMBAR REGION. — This region, to which it is somewhat difficult to assign precise limits, may conveniently be described, for practical purposes, as bounded (with reference to the surface of the body) superiorly by the last rib, below by the posterior half of the upper edge of the crest of the ilium, and externally by the posterior margin of the external oblique muscle. The series of lumbar spines would thus superficially separate the right from the left lumbar region. All the structures lying between the skin and such abdominal viscera as are in relation with the parietes, enter into the formation of the lumbar region, the symmetry of the two sides being broken by the fact that the right kidney lies lower than the left. These structures are met with in the following order from the surface:—1. the skin; 2. the cellular tissue; 3. the lumbar aponeurosis; 4. the musculo-aponeurotic layer; 5. the bones; and 6. the visceral layer. The blood-vessels and nerves are distributed amongst these tissues.

1. *The skin.*—The skin of the lumbar region is remarkable for its extreme thickness, and want of sensibility and mobility, being firmly fixed to the spines of the vertebræ.

2. *The cellular tissue.*—The cellular tissue consists of two laminæ, a superficial and a deep, the former very adherent to the skin, whilst the deeper is strengthened by several processes, derived from the aponeurotic layer.

3. *The lumbar aponeurosis.*—The lumbar aponeurosis, the strongest in the whole body, deter-

mines in a great measure the form of the region. It is attached firmly to the spinous process of the lumbar vertebræ, and its anterior surface gives origin to, and binds down the erectores spinæ muscles. The aponeurosis of the transversalis is here divisible into three vertical laminæ, namely, the posterior, which assists in the formation of the lumbar aponeurosis; the middle lamina, attached to the tips of the transverse processes of the lumbar vertebræ, and forming with the preceding a sheath for the erectores spinæ; and the anterior, attached to the bases of the transverse processes of the vertebræ, and forming, with the middle lamina, the sheath of the quadratus lumborum. The aponeurosis is limited by the posterior border of the external oblique muscle.

4. *The musculo-aponeurotic layer.*—The musculo-aponeurotic layer consists, on either side of the mesial line, of the mass of the erector spinæ muscle and the transverso-spinales internal to and below it; whilst between these muscles are the branches of the lumbar vessels and nerves. Beneath these lie the transverse processes of the lumbar vertebræ, the inter-transversales muscles, the laminæ of the vertebræ, with the ligamenta subflava; and, in a plane anterior, the quadrati lumborum, and ilio-lumbar ligaments. The psoas muscle enters the lumbar region.

5. *The bones.*—These consist of the lumbar vertebræ, with the inter-vertebral discs and ligaments, enclosing the cauda equina with its investments.

6. *Visceral layer.*—In front of the bones lie the pillars of the diaphragm; the inferior vena cava to the left, and the aorta to the right; on either side, the chain of the sympathetic, the lumbar glands, and the receptaculum chyli, and the commencement of the thoracic duct; and the commencement of the azygos major vein.

In front of the quadratus is a space occupied in its superior third by the kidney, and its lower two-thirds by the colon. About half the kidney lies in this space, of which the right is rather the lower of the two. The right colon is entirely enclosed in the peritoneum, whilst the left has only a partial investment of that membrane. The kidney lies external to the psoas, and upon the quadratus, corresponding with the outer side of the sacro-lumbar muscular mass. Certain anomalies in the relation of the kidneys are sometimes met with: they occasionally descend into the iliac fossæ, or they may float, owing to extreme length of the blood-vessels, which penetrate the hilum, and may then be felt loosely situated amongst the other abdominal viscera. On the psoas lie —the ureter internally; obliquely the spermatic or ovarian vessels, and the sympathetic; and externally the genito-crural nerve.

Blood-vessels.—The *arteries* which perforate and supply this region are the lumbar arteries. The *veins* correspond with the arteries; they anastomose, however, with the renal veins.

Nerves.—The nerves of the region are derived from the lumbar plexus, formed by the five lumbar nerves and last dorsal; whilst the sympathetic system is derived from the solar, renal, hypogastric, and lumbo-aortic plexuses.

Pathological and Clinical Relations.—The lumbar region is of great surgical importance, from the relation to its anterior aspect of certain abdominal viscera; from the numerous fasciæ which enter into its formation, and their relation to abscesses, growths, and bloody or urinary effusions; and from the fact that the operations of colotomy, nephrotomy, nephrectomy, and the opening of perinephritic abscesses are performed within its boundaries. Spina bifida has a great predilection for this region. Penetrating wounds in the lumbar region are liable to involve the cauda equina, owing to the wide separation which exists between the laminæ of the lumbar vertebræ. With regard to abscesses, connected with caries of the lumbar vertebræ, their situation is generally determined by their origin. When the posterior portion of the bodies or spines are affected, the pus is conducted backwards, being confined by the fascia lumborum. If the transverse processes or the anterior portion of the bones be the seat of disease, the pus will point anteriorly on the abdominal wall, being either bound down by the fascia transversalis, or conducted forwards between the abdominal muscles, in which case the pointing always takes place *above* Poupart's ligament. Renal or perinephritic abscesses often point at the border of the quadratus lumborum muscle, and may there be opened. Lumbar hernia protrudes at the so-called 'triangle of Petit.' The operations practised in the lumbar region are lumbar colotomy, nephrotomy, and nephrectomy. Of lumbar colotomy there are several modifications, but it is generally performed in the descending colon, which is usually uncovered by peritoneum posteriorly.

Other pathological and clinical relations of this region, which have many points in common with those of the iliac region, are referred to under that heading. Edward Bellamy.

LUMBRICUS.—By many practitioners this term is still employed to designate the large round-worm (*Ascaris lumbricoides*). The title is entirely a misnomer, having originated with Tyson (*Phil. Trans.* 1683) who called the common species *Lumbricus teres hominis.* All the larger round-worms infesting man and animals are apt to be called lumbricoids. Notwithstanding their general resemblance to ordinary earth-worms, their organisation is totally different. Occasionally, in practice, patients seek to deceive the medical attendant, by placing one or more earth-worms in the night-stool or chamber-pot. Quite recently the writer encountered an instance where a large garden lobworm (*L. terrestris*), about a foot in length, had been carefully selected for this purpose. The practitioner should not only be familiar with the differences of character presented by true and false worms of this kind, but should bear in mind that earth-worms cannot live in the human bladder and intestines. *See* Ascarides; and Round-worms.

T. S. Cobbold.

LUNACY, Law of.—The medical practitioner is frequently required to perform duties in connexion with lunacy, the satisfactory discharge of which requires that he should have some acquaintance with the legal enactments by which they are regulated. The statutes differ slightly in the three divisions of the kingdom. It will therefore be necessary, after describing what is

required under the law in England, to show where its requirements differ from those which exist in Scotland and Ireland. The details to be given here will only include what is necessary for the information of the general practitioner. Anyone who intends to devote himself specially to the treatment of the insane, or to receive one or more persons of unsound mind into his house, must comply with regulations which we cannot here set forth, but which are fully described in works upon the subject. When a person living in his own home is under treatment for insanity, the medical attendant is justified by the common law, in adopting any measures of restraint which may be necessary for safety or the proper treatment of the malady. This has been decided by the courts of law in recent cases. If, however, it is proposed to place the patient in an asylum, or to remove him to the charge of any person who is to derive profit either directly or indirectly from the proceeding, it is necessary that certain forms should be carefully observed.

In the case of a Chancery lunatic, an order by the 'Committee of the Person,' having annexed to it an office copy of the appointment of the Committee, is sufficient authority for the reception of the lunatic either into an asylum or a private house. In the case of other private patients, it is necessary to have what is called an 'order' and two medical certificates, as in the annexed form.[1] The order may be signed by anyone having a reasonable right to interfere, provided he is neither of the medical men signing the certificates, nor father, son, brother, partner, or assistant to either of them, nor professionally or pecuniarily connected, or to be connected in any way, with the person under whose charge the patient is to be placed. The person signing the order must have seen the patient within a month of the date of the order; and the order continues available for one month from the day of its date.

The medical certificates must be signed by registered practitioners in actual practice in England. They must have no interest, directly or indirectly, in the patient, in the establishment or house to which he is to be sent, or in his subsequent treatment; and they must not be in partnership with one another, nor otherwise professionally connected. A certificate when granted remains valid for seven days from the date of examination. The necessary form is here given. The words in italics describe a supposititious case, and are introduced merely to illustrate the manner in which the blanks must be filled up.

This document may be altogether in writing; but it is both desirable and convenient for all concerned that the regular printed forms should be used.[1]

Great care must be taken to have every detail of these documents complete and accurate; for it frequently happens that what may appear to many a trifling error renders a certificate invalid, and thus entails much inconvenience and sometimes distress. The foot notes attached to the certificate will be found sufficient as guides in the more important details, but the following hints will also be found useful:—1. The medical qualification must be given in full; 2. The house at which the examination was made must be accurately named, giving the name of the street, if there be any, and the number of the house; 3. The residence of the patient must be described with similar precision; and 4, The *name* of the person must be given, from whom the 'other facts' are obtained. The opinions at which the medical man must arrive before signing a certificate are two, and they are quite distinct. He has first to determine whether the patient is of unsound mind, and next whether it would be proper to place him under restraint. The determination that a person is insane does not necessarily imply that it is proper to place him under restraint. In stating the facts upon which the certificates are founded it must be borne in mind that they must be such as will appear to the Commissioners in Lunacy to be sufficient evidence of insanity; and great care must be taken to state them both intelligibly and accurately. There must be sufficient in the facts observed by the medical man himself to justify the opinion to which he certifies, the facts communicated by others being only accepted in corroboration of it; these may indeed be altogether omitted without invalidating the document. On this point the Commissioners have laid it down that the Legislature has been careful to guard against the facts communicated by others exercising

[1] MEDICAL CERTIFICATE.

Sched. (A.) No. 2, Sects. 4, 5, 8, 10, 11, 12, 13.

I, the undersigned, *William Harvey*, being a [a] *Member of the Royal College of Physicians of London*, and being in actual practice as a [b] *Physician*, hereby certify, that I, on the *third* day of *March* 1875, at [c] *number* 8 *Kent Street, Norwich*, in the county of *Norfolk*, separately from any other Medical practitioner personally examined *Edward Harris* of [d] *number* 8, *Kent Street, Norwich, Grocer*, and that the said *Edward Harris* is a [e] *person of unsound mind* and a proper person to be taken charge of and detained under Care and Treatment, and that I have formed this opinion upon the following grounds; viz.:—

1. Facts indicating Insanity observed by myself [f] *He states that his daughter, who has lived in his house for years, is a person unknown to him, who has been placed in the house as a spy, and made to look like his daughter. He states also that he believes Parliament intends to ruin him.*

2. Other facts (if any) indicating Insanity communicated to me by others [g] *His daughter, Mary Harris, informs me that he has been sleepless and restless and much depressed in mind for the last week, and that he has on that account been unable to attend to his business.*

Signed, Name, *William Harvey*
Place of abode, 31, *Chapel Street, Norwich.*

Dated this *third* day of *March* One Thousand Eight Hundred and Eighty.

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[a] *Here set forth the qualification entitling the person certifying to practise as a physician, surgeon, or apothecary, for example:*—Fellow of the Royal College of Physicians of London, Member of the Royal College of Surgeons of England, Licentiate of the Apothecaries' Society, *or as the case may be.*

[b] Physician, surgeon, *or* apothecary, *as the case may be.*

[c] *Here insert the street and number of the house (if any) or other like particulars.*

[d] *Insert residence and profession, or occupation (if any) of the patient.*

[e] Lunatic, *or* an idiot, *or* a person of unsound mind.

[f] *Here state the facts.*

[g] *Here state the information, and from whom.*

[1] These forms can be obtained at the law-stationers. As they are frequently wanted with the least possible delay, we mention the names of Messrs. Shaw and Sons, Fetter Lane, and of Messrs. Knight and Co., 90 Fleet Street, as firms in the habit of supplying them.

undue influence upon the mind of the medical man in granting his certificate, 'by requiring that this certificate shall be directly deducible from examination on a particular day and at a specified place, and that the opinion expressed therein as having been formed on such particular day shall be set forth as the result of his having observed at that time in the person under examination some specific fact indicating insanity.' In the statement of the facts observed, it is therefore necessary that at least one such fact or combination of facts should be mentioned as could not be affirmed of a person of sound mind. A frequent error is the stating of facts in such an imperfect manner that, though they may have been real indications of insanity as observed, the manner in which they are recorded makes them appear insufficient. It is sometimes stated, for example, that a patient 'believes himself to be possessed of great wealth;' but it is necessary that we should also state whether this is or is not a well-founded belief. And it is not infrequent to find this necessary adjunct absent from the statement. One actual statement of facts, for instance, was 'his appearance, manner, mode of speaking, as well as his conduct,' a detail of circumstances which had probably proved conclusively enough to the writer that the patient was insane, but which afforded no substantial information to those who merely read the statement. When the case is urgent, and it is found impracticable to obtain certificates from two medical men, the patient may be received into the asylum or house upon a single certificate. But this entails the necessity of obtaining two additional certificates from other medical men within three clear days after the reception of the patient.

A private patient may be discharged from the asylum or house in which he has been detained, on the written authority of the person who signed the order for his admission. If a patient should die while under detention it is necessary to give notice of the death to the Coroner and to the Commissioners in Lunacy.

In the case of pauper lunatics the procedure is somewhat different from what is required for private patients. Anyone aware of the existence of an insane pauper in a parish, ought, if the case is a proper one for asylum treatment, to give notice to the relieving officer or the overseer. When a district medical officer under the poor law becomes aware of such a circumstance it becomes his statutory duty to give this notice in writing within three days after obtaining such knowledge. The relieving officer or overseer may then place the patient in an asylum upon one medical certificate, accompanied either by the order of a justice of the peace, or by an order signed conjointly by himself and an officiating clergyman of the parish.

In order to place a patient in an asylum in Scotland, a petition accompanied by a statement and two medical certificates has to be presented to the sheriff.[1] In the case of a private patient the person signing the petition must state the degree of kinship or other relation in which he stands to the patient. In the case of a pauper the petition must be signed by the inspector of the poor. In either case, if there be reasonable ground for so doing, the patient may be placed in the asylum on what is called a 'certificate of emergency,' signed by one medical man. If, however, the order of the sheriff is not obtained within three days thereafter, the patient must be discharged. In the case of a patient placed for profit in a private house in Scotland, the fact must be reported to the General Board of Lunacy for Scotland, and the sanction of the Board obtained.

The procedure required for placing a patient in an asylum in Ireland is generally similar to what is required in England. For admission to a private asylum, an order and two medical certificates must be filled up and signed, subject to regulations resembling those already described as enforced in England; but the facts indicating insanity do not require to be stated in the certificates. Pauper patients are placed in district asylums, and are admitted to these institutions on application being made at the asylum of the district in which the patient resides. The necessary form is obtained at the asylum. It consists of (1) a declaration to be made before a magistrate, that the patient is insane and destitute, and has no friend able or willing to pay for his board in an asylum; and to this is annexed a statement descriptive of the patient; (2), a certificate by a magistrate, and a clergyman or poor law guardian, in corroboration of the declaration; and (3), a medical certificate of insanity. When these forms have been filled up, it is necessary to wait until it is notified to some of the friends of the lunatic that there is room for him at the asylum. The procedure specially designed for the committal of dangerous lunatics is, however, frequently adopted in placing paupers in asylums. As this necessitates the lodgment of the patient in an ordinary prison, it is evidently a course which ought to be avoided, and which the medical practitioner ought specially to discourage. According to this procedure the patient requires to be apprehended by the police, and brought before two justices of the peace. They call to their aid the medical officer of the Dispensary District, and either discharge the patient or order his removal to the asylum. Patients who are not destitute, but whose friends are unable to pay the rates of board charged in private asylums, are received into district asylums at low rates, upon application being made at the asylum in a similar manner to that already described for paupers. The chief difference between the two forms is that in the case of patients not destitute, the medical certificate requires to be signed by two medical men instead of only by one.

JOHN SIBBALD.

LUNATIC (*luna*, the moon).—SYNON.: Fr. *Lunatique*; Ger. *Mondsüchtig*.—A designation given to persons suffering from mental disorder, because such subjects were formerly believed to be peculiarly affected by lunar influences. The term is used popularly as synonymous with insane. In medical literature it is seldom employed, but the legal relations of the word are important. The adjective lunatic is also used

[1] The regular printed forms for Scotland may be obtained from Messrs. T. and A. Constable, 11 Thistle Street, Edinburgh.

to signify that the object with which it is associated is connected with insanity, as *lunatic asylum*. *See* INSANITY.

LUNGS, Diseases of.—SYNON.: Fr. *Maladies du Poumon*; Ger. *Krankheiten der Lungen*. Under this title there will be described in the following pages, with certain exceptions, the various morbid conditions which affect the pulmonary organs. Pulmonary phthisis is so common a disease, so complex and variable in its pathology, and so closely associated in its ætiology and symptoms with the entire organism, that it will be most conveniently described apart from the other diseases of the lungs (*see* PHTHISIS). Certain other diseases which involve the lungs, if not the lung-tissue proper, and which in some nosological systems are described as pulmonary diseases—namely, asthma, diseases of the bronchi, and diseases of the pleura, will also be found described apart from the present connection, and under their several headings. Again, disorders of respiration, such as dyspnœa, orthopnœa, and 'Cheyne-Stokes respiration,' although frequently associated with diseases of the lungs, are in other instances referable to some morbid condition of other parts, such as the blood, the heart and circulation, or the nervous apparatus of breathing, and they will therefore be discussed in a distinct article (*see* RESPIRATION, Disorders of). The more important special clinical phenomena of disease of the lungs—namely, cough, expectoration, hæmoptysis, and the various physical signs, also demand more detailed and complete consideration than can be devoted to them in connection with the various pathological conditions to which they are due. *See* COUGH; EXPECTORATION; HÆMOPTYSIS; and PHYSICAL EXAMINATION.

After the separation of these subjects from that of diseases of the lungs, there remain for consideration under this head a large number of morbid conditions, which rank of the very first importance in practical medicine, and which will now be enumerated. The morbid processes which affect the lungs may be readily divided into two great groups—namely, first, those which are not essentially different from similar processes in other parts of the body; and, secondly, those which are quite peculiar to these organs.

First, with respect to the former group, the lungs, like the other great viscera, may present any of the ordinary morbid conditions, which affect either entire organs, or the several tissues of which they are composed. Thus the lungs may be the subject of various injuries, leading to *perforation* or *rupture*, and may present certain *malformations* and *misplacements*. They may undergo such alterations of nutrition as end in *atrophy*, *hypertrophy*, or certain *degenerations*. Disturbances of circulation give rise to well-defined pathological conditions, such as *anæmia*, *congestion*, *hyperæmia*, '*apoplexy*,' *embolism*, *infarction*, *œdema*, and *hæmorrhage*. The inflammatory process leads to a greater variety of pathological changes in the lungs than in perhaps any other organ, and which are known as *catarrhal*, *croupous*, and *chronic pneumomia*, *abscess*, *cirrhosis*, *gangrene*, and some forms of *phthisis*. *Morbid growths* of all kinds, including *malignant disease*, may involve the lungs, whether primarily or secondarily. *Syphilis*, besides actually involving the lungs, occasionally determines or modifies the occurrence of other pathological processes within them. Various *parasites*, especially *hydatids*, are occasionally tenants of the pulmonary organs.

Secondly, the morbid conditions which are *peculiar* to the lungs are such as depend upon their special structure, relations, and functions. Thus the relation between the pulmonary tissue and the pressure within and around the lungs may be so disturbed as to lead, on the one hand to *collapse* or *compression*, or on the other hand to *emphysema*. Their communication with the atmosphere, and the constant interchange that is going on between the contents of the lungs and the external air, have an important influence upon the origin, distribution, progress, and treatment of many of the diseases which affect them; whilst the length and complexity of the respiratory passages and their liability to disease, lead to many disturbances of the pressure, the circulation, and the nutrition within the lungs, and thus to collapse, hyperæmia, inflammation, and even destructive disease. The relation of the lungs to the circulation has an equally important influence upon them from a pathological point of view. Constituting as they do the channel of communication between the right and the left sides of the heart, the pulmonary vessels are involved in all the disturbances which affect the cardiac circulation, whether due to actual disease of the valves or of the walls, or to simple functional derangement of that organ. Congestion, œdema, embolism, infarction, hæmorrhage, and some forms of inflammation of the lungs, are the ordinary results of such circulatory disturbance of a temporary kind; and when it is more protracted, *brown induration*, as well as diseases of the bronchi and pleura, are likely to result.

Such are the principal conditions which determine and influence diseases of the lungs; and we shall here enumerate these in the alphabetical order in which they will be found referred to in the following pages:—1. Abscess. 2. Albuminoid Disease. 3. Anæmia. 4. Apoplexy. 5. Atrophy. 6. Brown Induration. 7. Cancer. 8. Cirrhosis. 9. Collapse. 10. Compression. 11. Congestion. 12. Consumption. 13. Degenerations. 14. Embolism. 15. Emphysema. 16. Gangrene. 17. Hæmorrhage. 18. Hydatids. 19. Hyperæmia. 20. Hypertrophy. 21. Induration. 22. Infarction. 23. Infiltrations. 24. Inflammation — Croupous, Secondary, Catarrhal, and Chronic. 25. Inflation. 26. Malformations. 27. Malignant Diseases. 28. Malpositions. 29. Morbid Growths. 30. Œdema. 31. Perforation. 32. Rupture. 33. Syphilitic Disease; and 34. Tuberculosis.

LUNGS, Abscess of.—SYNON.: Fr. *Abcès du Poumon*; Ger. *Lungenabscess*.

DEFINITION.—Circumscribed suppuration of the pulmonary tissues.

ÆTIOLOGY AND PATHOLOGY.—An acute primary inflammation of the lungs may occasionally lead to the formation of abscess. Much more commonly, however, pulmonary abscesses

are the result of secondary or infective inflammations, and they are then, for the most part, associated with pyæmia.

Of acute primary inflammations of the lung, as causes of abscess, we have to consider those due to mechanical injuries, and those associated with acute pneumonia and with gangrene. With regard to the former it is only necessary to remark that mechanical injuries, as fractured ribs, penetrating wounds of the thorax, the lodgment of foreign bodies, &c., may cause suppuration, and so occasionally lead to the formation of abscess. That acute pneumonia may, in rare cases, terminate in abscess of the lung, has already been stated. Such a result appears to be favoured by a bad constitution, and by any circumstances which tend to impair the general health, either before or during the disease. The abscess is more common in the upper than in the lower lobes. Lastly, circumscribed gangrene of the lung occasionally terminates in abscess. This takes place by the evacuation of the necrotic tissue through the bronchi, and the formation of a pyogenic membrane from the walls of the cavity, which generates pus. The cavity may ultimately close by granulation and cicatrisation. Abscesses of primary origin are usually single.

Secondary or infective abscesses of the lung owe their origin to the dissemination of infective substances, derived from some focus of primary inflammation, by means of the blood-vessels or lymphatics. They are usually due to a general pyæmic process; and consequently the blood-vessels are the channels by means of which the infective substances are conveyed to the lungs. These substances are sometimes sufficiently large to block the pulmonary vessels, the formation of the abscess being preceded by a process of hæmorrhagic infarction. In other cases the suppuration occurs without any evidence of such infarction taking place. These abscesses are almost invariably multiple. They vary in size from a pin's head to a walnut, and are usually most abundant near the surface. They are commonly surrounded by a thin zone of dark red consolidation; and when adjacent to the pleura, this membrane over them is always inflamed.

Symptoms and Physical Signs.—The formation of abscess in the lung is rarely attended by any marked clinical phenomena, the symptoms of the disease, in the course of which the localised suppuration takes place being, for the most part, but little modified by its occurrence.

When acute pneumonia terminates in abscess, either the rapid fall of the temperature which constitutes crisis does not occur, or, what is more common, its occurrence is followed by pyrexia of an irregular type. The physical signs of consolidation also persist, and there is usually great prostration. Sometimes, owing to the opening of the abscess into a bronchus, pus is coughed up; and then, if the communication with the bronchus remain free, signs of cavity are discoverable. Before such partial evacuation of its contents, the detection of the abscess by physical examination is usually impossible. The expectoration of sputa containing large quantities of pus, and often a little blood, may continue for some weeks; the signs of prostration may gradually increase; and death may ensue in the course of from two to three months, and often earlier. Partial or complete recovery may, however, take place, the cavity becoming quiescent and secreting only small quantities of pus; and complete cicatrisation may ultimately occur. In exceptional cases the abscess opens into the pleural cavity.

Abscesses of the lungs occurring in the course of pyæmia rarely give rise to any special symptoms or physical signs. They are usually much smaller than primary abscesses; and death commonly ensues before any of them have attained sufficient magnitude to influence the general phenomena of the disease.

Diagnosis.—The diagnosis of abscess, occurring in the course of pneumonia, rests mainly upon the persistence and characters of the pyrexia; upon the physical signs of excavation supervening on those of pulmonary consolidation; and upon the expectoration of sputa containing pus. Pyæmic abscesses rarely admit of diagnosis. Their existence may be suspected if, in cases of pyæmia, pleural friction-sounds are audible over different portions of the chest.

Prognosis.—Abscess resulting from pneumonia very commonly proves fatal in from one to three months; it may, however, as already stated, ultimately terminate in partial or even complete recovery. The development of abscesses in the lungs in the course of pyæmia does not appear to influence the general prognosis.

Treatment.—Abscesses of the lungs rarely admit of any special treatment. Their occurrence, however, indicates the importance of doing all that is possible to maintain the strength of the patient. T. Henry Green.

LUNGS, Albuminoid Disease of.—In advanced cases of albuminoid disease, the lung-tissues may present more or less of this morbid change; but it is of no practical importance, for it does not give rise to any evident symptoms, nor does it have any specially injurious effect upon the patient.

LUNGS, Anæmia of.—Synon.: Fr. *Anémie du poumon*; Ger. *Lungenanämie.*

Definition.—A deficiency of blood in the lungs.

Anæmia of the lung may be *general* or *local.*

Ætiology.—Besides hæmorrhage and the other causes of general bloodlessness, there are certain local causes which produce anæmia of the lung. In senile atrophy, and in pulmonary vesicular emphysema, anæmia is associated with destruction of capillaries. Local or partial anæmia of the lung is the immediate result of embolism of the branches of the pulmonary artery. It rarely happens that the main vessel is entirely obstructed by an embolus; but it, or more commonly one of its main divisions, may be compressed or obliterated by the invasion of a malignant growth or aneurism. Aneurism of a branch of the pulmonary artery within the lung usually causes anæmia of the portion to which the vessel is distributed.

Anatomical Characters.—In extreme anæmia, as after death from hæmorrhage, the lungs and the bronchial mucous membrane are ex-

ceedingly pale from absence of blood. They are of course lighter in weight than natural, but in other respects unchanged. In the general disease known as anæmia, the lung partakes with other organs of the general deficiency of red blood; but in this condition, it being not so much in bulk as in quality that the blood is deficient, the lungs are of normal weight, but paler and more moist than natural, sometimes slightly œdematous.

Effects.—The consequences of pulmonary anæmia, when long-continued, are atrophy of its texture, as in senile atrophy and vesicular emphysema, and in local deficiency of blood from partial obstruction of a large branch of the pulmonary artery. In complete obstruction of vessels from embolism, death and sloughing of the deprived area of lung is the consequence. The sudden arrest of circulation through a limited portion of the lung, gives rise to stress on the collateral circulation, the result of which is often hæmorrhage.

Symptoms.—The dyspnœa and palpitation observed in anæmia are traceable to the anæmic condition of the lungs, and have their rationale in the necessity for an increased diligence of respiration, to enable the diluted blood to gather sufficient oxygen for carrying on the various combustion-processes of life. The remarkable gasping and restlessness seen in cases of fatal hæmorrhage, are really the signs of asphyxia from pulmonary deprivation of blood. The symptoms of general or local pulmonary anæmia dependent upon emphysema, embolism, &c., are lost in those of the more important diseases.

Treatment.—There is no special treatment for pulmonary anæmia. R. Douglas Powell.

LUNGS, Apoplexy of.—A synonym for extravasation of blood into the lungs. *See* Lungs, Hæmorrhage into.

LUNGS, Atrophy of.—Syn.: Senile emphysema; Fr. *Atrophie du Poumon*; Ger. *Lungenatrophie.*

Definition.—A wasting of the constituent elements of the lungs, from defective nutrition.

Varieties.—Atrophy of the lung may be:—(*a*) *general*, in which all the tissues of the whole of both lungs are wasted, as in senile atrophy; or it may be (*b*) *local*, in which all the tissues of a portion of the lung are wasted, as in the atrophy that results from a local diminution of blood-supply; or (*c*) it may be *partial*, in which some of the tissues are atrophied coincidently with increased growth of other tissues, as in some cases of so-called 'hypertrophous emphysema,' and in 'cirrhosis' of the lung.

Ætiology.—The cause of simple atrophy of the lungs is that general failure of nutrition which is natural to advanced age. Hereditary predisposition may determine an earlier failure of nutritive change in the lungs. The strongly-marked tendency of vesicular emphysema to recur in successive generations is certainly in favour of such a tendency to premature impairment of tissue being inherited.

Over-stretching of the walls of the air-cells in emphysema, with the consequent impediment to circulation, is an important cause of subsequent atrophy in this disease. Collapse and anæmia of lung from pressure from without, or from the pressure of a growth or aneurism upon one of the pulmonary vessels, cutting off the blood-supply, or on a large bronchus, diminishing the respiratory function, may cause atrophy of the whole or of a part of one lung.

Anatomical Characters.—The appearance of an atrophied lung may be best seen in a case of natural or senile atrophy. The lung is small, light, anæmic, more or less deeply pigmented, drier in texture and less firm and resisting than natural, pitting on pressure from want of elastic resilience, and capable of being squeezed into a very small compass. The air-cells appear to be increased in size; and at some portions, if the lung be inflated and dried, large cells may be seen, evidently resulting from the coalescence of two or more infundibula. Across such cells filaments, the remnants of small bronchi and blood-vessels, may extend. The pulmonary artery and its branches are diminished in size, and the bronchial tubes are also thinned.

Microscopical characters. — The atrophic process commences at the vesicular septa, which project inwards to subdivide the infundibula, or alveolar spaces of the lung, into true air-cells, or alveoli. The process is one of simple withering and obliteration of capillaries, dependent on diminished respiratory function and blood-volume. The septa dwindle down to mere ridges upon the infundibular walls; and these walls in their turn become thinned even to perforation and coalescence of several air-spaces. Thus, without any corresponding enlargement of lung, there is an apparent enlargement of air-cells from the simplification of structure. A certain degree of fatty degeneration, affecting especially the minute vessels and the nuclear remains of the pulmonary epithelium, is associated with this simple atrophy, as with all other atrophic processes.

When atrophy of the lung is associated with, or the result of, other diseases, as emphysema or forcible collapse, the process is essentially the same, but is combined in the former case with over-stretching of the air-cells, and more or less thickening of the fibrous tissues derived from the bronchial and perivascular sheaths, from repeated congestions. Thus we have a larger and heavier lung; and, in the later stages, more marked fatty degeneration of its fibrous texture.

In cases of atrophy from the long-continued pressure of fluid in the pleura, the pleura is always thickened from the original inflammation, and fibrous processes are directed inwards from it between the lobules, so as to render difficult any subsequent expansion of the lung.

In the case of atrophy from compression of the lung by fibrous growth or fluid effusion, we have again often a heavier lung from increase of fibrous tissue. It is obvious that the increase in weight must always be due to attendant, often determining, disease.

Effects and Symptoms.—The consequences of the partial atrophy of lung which accompanies the 'large-lunged' emphysema of advanced middle life are very grave. Extensive obliteration of the pulmonary capillaries, without a corresponding diminution in the blood-volume, induces a stress of circulation, a mechanical congestion, which ultimately tells back through

the right heart upon the whole venous system. The damaged elasticity of the lung impairs the mechanism, as the atrophy of the alveoli impairs the function of respiration. In senile emphysema, however, the lung-atrophy, being but a part of a general atrophy of all the tissues and of the blood, causes no discomfort, provided no extra effort is attempted and no bronchitis supervene. Local atrophy of the lung has its symptoms merged in those of the predominant disease.

Physical signs.—In senile atrophy of the lungs the chest-capacity is diminished in all directions to accommodate the small lungs. The lower ribs are approximated and their obliquity greatly increased; the upper intercostal spaces are depressed. The chest-movements are very limited. The percussion resonance is generally increased over the chest, except over the præcordial region, which is less covered by lung than natural. The respiratory murmurs are simply enfeebled, not altered, unless there be some bronchitis present. It has been said that there may be some effusion into the pleura in atrophy of the lung, to fill up the space vacated by the shrunken organ. The mechanism of such an effusion is, however, quite inconceivable.

Complications.—There are no complications necessarily incident to senile atrophy of the lung. Bronchitis not uncommonly, however, supervenes, and proves fatal to the patient.

Treatment.—The treatment of senile atrophy of the lungs simply consists in shielding the aged person from the causes of bronchitis.

R. Douglas Powell.

LUNGS, Brown Induration of.— The condition recognised by this name by Virchow and Laennec, is one which is sometimes observed after prolonged congestion of the lungs, particularly that which results from disease connected with the mitral orifice. The morbid change consists mainly in excessive pigmentation, the pigment accumulating not only in the interlobular tissue, but also in the alveoli and minute bronchi, where it is enclosed in enlarged epithelial and granular cells. At the same time the capillaries are dilated, the interstitial tissue is increased, and probably the alveolar walls are thickened. The pigment is granular, and of a yellowish colour; it is derived from the blood; and seems to be of the nature of hæmatoidin. It may become brownish, reddish, or even black; and ultimately may be found free. The extent and degree of brown induration vary much in different cases. When the change is marked, the lungs are enlarged, heavy, firm, incompressible, and inelastic, not collapsing on exposure. They present various tints, from yellowish to reddish-brown. This alteration in colour is also evident on section, and red spots are often seen, shading into black, while a brownish fluid may be expressed. Brown induration is associated with congestion of other parts of the lungs, and often with infarctions. It cannot be clinically recognised apart from these conditions, unless the affected organs should present physical signs of consolidation in cases of known pulmonary congestion from mitral disease. No special treatment is called for.

Frederick T. Roberts.

LUNGS, Cancer of.—*See* Lungs, Malignant Disease of.

LUNGS, Cirrhosis of.—A synonym for chronic pneumonia. *See* Lungs, Inflammation of.

LUNGS, Collapse of.—Synon.: Apneumatosis; Fr. *Affaissement pulmonaire*; Ger. *Lungencollapsus.*

Definition.—Simple diminution in size of the whole or of a part of a lung, with reduction of the volume of the contained air, and caused by interference with its free entrance in inspiration.

Ætiology.—The causes of collapse of the lung are either *intrinsic* or *extrinsic*; and frequently the two classes of causes are combined. The *intrinsic* causes present actual obstruction of the respiratory passages, and include all diseases of the larynx, trachea, and bronchi, attended with inspiratory dyspnœa, whether due to the pressure of external tumours, to affections of the passages themselves, or to the presence of inflammatory products, blood, and foreign bodies within them. To this class of cases belongs the collapse of the lung which is apt to follow infantile bronchitis, when the tubes become obstructed, and there is no power to expectorate. All causes that interfere with respiratory efficiency favour the occurrence of the condition named. A plug of mucus may be drawn, in inspiration, deeper and deeper into the bronchial tubes, which it obstructs, and acting like a 'ball plug,' allows the expulsion of air in expiration, but interferes with inspiration; the air not being replaced, apneumatosis is developed; and as there is no air behind the plug of mucus, cough is powerless to expel it. In children, bronchial inflammation is exceedingly common, and the smaller tubes being proportionately smaller in the child than in the adult, the danger of collapse is increased. When children under five years of age die of bronchitis and allied affections, apneumatosis is almost invariably present; and 25 per cent. of the total mortality of infants may be safely set down to this cause. Partial collapse of the lung from pressure on the respiratory passages will be found described in the article Mediastinum, Diseases of. The *extrinsic* causes of pulmonary collapse are certain conditions of the walls of the chest, which diminish the force of the inspiratory act, such as paralysis or debility of the inspiratory muscles, and softness of their bony attachments. Muscular paralysis is seen in injuries to the cord. Debility of the respiratory muscles may often be observed before death. Collapse of the lung is sometimes, although rarely, met with in adult life, when great prostration occurs in the course of fever, and respiration is impeded by pulmonary congestion. Asssociated as it is with softness and weakness of the ribs, rickets is one of the most frequent causes of collapse of the lungs. The action of the inspiratory muscles may be still further interfered with by abdominal distension, or by the binding up of the abdomen of the infant with tight bandages. The danger of collapse is lessened when the ribs have gained firmness and fixity, and when, raised by the respiratory muscles, the thoracic cavity is enlarged, and the lungs are consequently expanded.

Anatomical Characters.—The whole of one lung or of one lobe may be affected, but a lobule or a part only of the lung is usually involved, the affected lobules being abruptly separated from those adjoining. As a rule several patches of collapse occur in each lung, having a darker colour and more depressed surface than the healthy parts. The lower margins of the left lower lobe are most frequently affected. The collapsed portions of lung are similar to the liver in consistence; they resist pressure, are non-crepitant, are smooth on section, and sink in water. The bronchi are filled with mucous fluid; there is an entire absence of air in the collapsed parts. On inflation the affected portion assumes a natural appearance, unless considerable congestion exists; whereas in pneumonia inflation cannot restore the lung to its natural appearance. In pneumonia pleurisy is rarely absent; but in collapse, uncomplicated with diathetic disease, the pleura is invariably healthy.

Symptoms.—The symptoms of collapse of the lung vary greatly with the cause, rapidity, and extent of the morbid condition. In severe cases, for example, in the collapse that follows bronchitis in very young subjects, the symptoms are peculiar. There is great prostration, debility, restlessness, and sleeplessness. The temperature falls; the surface becomes cold, blue, or dusky; the eyes become shrunken; and the pulse is quick and small. There is a constant feeble whining cry. Respiration is very quick and shallow, as high as 70 to 80 or even 100 per minute. The rhythm is changed, the interval being between inspiration and expiration, instead of after expiration. There is no pain as in pleurisy. The cough is constant and impotent; is often followed by a cry of impatience; and differs much from the suffocative cough of bronchitis.

On examining the chest, the lower part is found retracted and diminished in diameter. The intercostal spaces sink in inspiration, and move outwards slightly in expiration. When the collapse is extensive the percussion is dull and resistant, unless the affected lobules are interspersed among the healthy ones. The respiratory murmur is lost over the affected parts, though conducted breath-sounds, of a bronchial character, and rhonchi are generally audible almost universally. In the simpler cases of collapse of the lungs, such as occur in pertussis during the severe fits of coughing, some of these symptoms and signs may be suddenly developed, and again speedily disappear.

Diagnosis.—Apneumatosis may be distinguished from croupous pneumonia by the comparative rarity of the latter disease in infancy; and by absence of the great heat of skin, and of fine crepitation on auscultation. From extensive miliary tuberculosis it is diagnosed by the absence of advancing symptoms of constitutional disorder, though the two conditions may co-exist. In pleurisy the dulness on percussion, and the absence of respiratory sounds at the base, are much more marked than in apneumatosis. Congenital collapse or *atelectasis*, is a condition which has to be diagnosed from infantile collapse or *apneumatosis*. Readily separable by symptoms, these two conditions may be indistinguishable by physical signs. In atelectasis the lung retains, in whole or in part, its fœtal condition, nature having failed to establish respiration and fit the child for its new mode of existence. In apneumatosis the once permeable lungs cease to admit air, and thus death from apnœa occurs without any apparent structural change being discoverable, save that the respiratory organs bear the appearance of fœtal, unexpanded lungs.

Prognosis. — The prognosis in collapse of the lung is favourable if the affection is recent, and the child healthy, with fair muscular power, and under favourable hygienic conditions. On the contrary, the disease is generally fatal if it involve a considerable extent of lung, especially if it supervene on atelectasis. Death usually occurs from slow asphyxia, the effect being the same as if the size of the lung were reduced by the removal of the affected parts. As much as half of the entire lungs has been found involved, thus fully accounting for the quickened respiration, the distress, and the dyspnœa, and for the bloodlessness and extreme pallor, with cold, blue extremities. The fatality of whooping-cough in infants is mainly due to the ready collapse of the lungs, specially when the child is badly nourished and breathing impure air. The natural course of the disease is from bad to worse; more lung is involved each day; and death occurs after two or three weeks from slow asphyxia. If collapse follows acute bronchitis death often ensues rapidly, but if recovery takes place the lungs are slow to regain activity, and the seeds of future mischief remain. After an attack of pneumonia complete absence of breath-sounds may exist for a time, and then suddenly —after a blow, shock, or violent cough—air enters the collapsed portion of lung, and the respiratory sounds assume a normal character.

Treatment.—When this affection was looked upon as a form of pneumonia it was treated by depletion. Now that we realise that it is not of an inflammatory character, our object must be not to lower vitality but to diminish excessive secretion. Slight counter-irritation, by means of stimulating embrocations, is useful. An emetic of ipecacuanha will help to remove accumulation if the patient is not too weak. Expectoration may be promoted by small doses of the same drug. When the lungs are extensively involved, vital power must be kept up by the help of ammonia, steel, phosphates of iron, port wine, and beef-tea; and the food must be so designed as to be digestible by the stomach of the infant.

E. Symes Thompson.

LUNGS, Compression of.—Synon.: Fr. *Compression du Poumon*; Ger. *Lungencompression.*

Definition.—Diminution in size of the whole or of a part of a lung, associated with reduction of the volume of the contained air, and caused by pressure on the pleural surface.

Ætiology.—Compression of the lung may arise in the course of numerous diseases or injuries affecting the chest; the compressing influence being either gaseous, liquid, or solid.

First, the admission of *air* to the pleura from without, through a perforating wound, as from a sword or bayonet thrust; or from within, as by

rupture of an air-cell, or the extension of pulmonary ulceration through the pleura, produces in either case compression. If no previous pleurisy has existed the compression is complete; but if, on the other hand, long-standing pleurisy has caused adhesion, compression cannot take place, or will be but partial. Pneumothorax arising without perforation may be due to the evolution of gas from gangrene, or to the decomposition of pleuritic fluid; or the gas may be directly secreted within the pleura, taking the place of serum absorbed after pleuritic effusion. Besides the causes named, perforation may arise from fractured ribs with pulmonary laceration, or from contusion of the lung without fracture; from ulcerative perforation of lung, either tuberculous or gangrenous; from pulmonary apoplexy, hydatids, cancer, empyæma, abscess; from rupture of the lung in whooping-cough; from perforation of the lung from without, by diseased and suppurating bronchial glands opening into the pleura and bronchi; and from rupture or ulceration of the œsophagus, opening into the pleura. Of this long list, omitting the surgical cases, nine out of ten are due to phthisis.

Secondly, compression may arise from the presence of *fluid*, such as pleuritic effusion, acute or chronic; passive, non-inflammatory effusion, as in hydrothorax; or blood, as in hæmatothorax.

Thirdly, compression of the lung by *solids* is seen in the case of various tumours of the chest, whether originating in the mediastinal structures, in the lungs, or in the thoracic parietes.

In a fourth class of cases compression of the lung is the result of the enlargement of neighbouring parts, other than the thoracic viscera; and especially of the abdomen, as in ascites, and tumours of the liver, spleen, or ovaries.

Anatomical Characters.— Compression of the lung may be either general or local, complete or partial. A lung compressed by pleuritic effusion is found to be reduced in volume, noncrepitant, dense, and quite insusceptible of inflation. The blood is coagulated in the affected lobes, the clot being often decolourised and adherent to the walls of the vessels, many of which are impervious, or altogether obliterated; while the pervious vessels and the air-cells of the adjacent parts are distended, and emphysema is produced. In other cases, the compressed lung proves to be anæmic, tough, and dry.

In cases of slow recovery from chronic empyæma the lung is often found bound down and thickened, having very little normal pulmonary tissue remaining. The thoracic cavity vacated by the shrunken lung is occupied by the displaced heart, and sometimes by the extension of the sound lung across the middle line.

When perforation occurs with admission of air from the bronchi to the pleural cavity, the atmospheric pressure distends the pleura, and tends to displace the mediastinum and the other lung. The heart, too, being unsupported, is pressed against the healthy lung, and may be displaced to a very considerable extent.

Symptoms and Physical Signs.—The symptoms of compression of the lung vary greatly in accordance with its causes, the rapidity of onset, and the extent and degree of compression. If pleuritic effusion be very rapid, the dyspnœa may be exceedingly urgent. After perforation of the pleura with sudden collapse of the lung, there also occur acute pain, dry cough, and painful spasms of the intercostal muscles. The pulse is frequent, feeble, and often irregular. Symptoms, more or less acute, of inflammation may follow. In other instances the symptoms are those of hydrothorax, or of intrathoracic tumour.

The physical signs of compression of the lung are chiefly those of the associated cause, such as pneumothorax, pleurisy, hydrothorax, or intrathoracic tumour; and partly certain phenomena characteristic of the physical condition of the lung itself. The latter vary considerably with the degree and extent of compression, but they may be described in general terms as follows: —Either increased clearness of the percussion sound over the area of compressed lung, with tubular or rarely even tympanitic quality, especially in children, or in extreme cases of compression complete loss of resonance; indefinite, weak, but occasionally rather blowing or tubular respiratory sound, sometimes mixed with scanty, dry, subcrepitant rhonchus; and exaggerated loudness and ringing quality of vocal resonance. A further description of these symptoms and signs will be found under the headings of the various causes of compression referred to.

Diagnosis.—The diagnosis of compression of the lung is in general simply the diagnosis of the condition on which it depends.

Prognosis.—The prognosis depends on the cause of the compression. Thus in pneumothorax it is unfavourable, though recovery may take place. In hydrothorax the prognosis is unfavourable, as it is usually an evidence of formidable, if not incurable, organic disease. In pleurisy, if the effusion has been rapid, met by prompt treatment, and uncomplicated with hectic, complete recovery may take place without much compression of lung or distortion of chest; but incompletely-cured pleurisy is too frequently the first incident in the history of phthisical disease. In empyæma the prognosis is more favourable than in pneumothorax or hydrothorax.

Treatment.—Little need be said as to the treatment of lung-compression. It resolves itself into that of the intercurrent or causative diseases. Bearing in mind the injury done to the lung by compression, efforts should be made to relieve the lung before it has been irremediably bound down. The early adoption of paracentesis thoracis is the most practical means of gaining this end in pleuritic effusion. Remedies calculated to remove effusion and thus relieve the lung should be given, remembering that the more speedy the relief given to the lung the more complete will be the cure. Suitable movements of the chest might be ordered subsequently, with the view of promoting expansion of its walls and of the lung. E. Symes Thompson.

LUNGS, Congestion of.—*See* Lungs, Hyperæmia of.

LUNGS, Consumption of.—*See* Phthisis.

LUNGS, Degenerations of.—Changes of

a degenerative character in connection with the lungs constitute an important element in some pulmonary diseases, or they may be the sole morbid condition present. They are of the following nature :—

1. *Albuminoid.*—This is only occasionally noticed, in marked cases of general albuminoid disease.

2. *Fibroid.*—Changes leading to a more or less fibroid condition of the pulmonary tissue are of common occurrence, but it is not always easy to determine whether they should be regarded as due to a chronic inflammatory process, or to degeneration, and pathologists differ in their views on this point. As a degeneration, the fibroid change may be considered as most important in connection with emphysema, and it is regarded by some authorities as an element of much consequence in the causation of many cases of this disease. It also follows long-continued congestion, and collapse or compression of the lung from any cause. Of course much fibroid or fibrous tissue is found in the lungs in many cases of phthisis, and in connection with pleuritic adhesions and other conditions, but this state must be looked upon mainly as of inflammatory origin. The effects of these changes are to make the lung-tissue firmer and tougher, but at the same time to diminish or destroy its elasticity, the elastic tissue being more or less displaced. Hence, if the lungs be exposed to any distending force, they cannot recover themselves properly, and the air-vesicles remain more or less permanently dilated.

3. *Fatty.*—This degeneration is also regarded by some pathologists as one of the main elements in originating many cases of emphysema of the lungs, and also as one of the actual conditions in this disease. Here, again, the lung-tissue is impaired in its elasticity and resisting power to distension, but it is not tough. Granular fat may be visible under the microscope.

4. *Pigmentary.*—The lungs become the seat of more or less pigmentation with increasing age. They are also markedly affected in certain occupations in which carbonaceous matters are inhaled. In so-called brown induration of the lungs there is an abundance of pigment.

5. *Senile.*—The lung-tissue undergoes atrophy, with more or less loss of elasticity, owing to wasting of the elastic tissue with increasing age, and even a fatty degeneration may take place. Hence, in such subjects emphysema is readily set up by causes which would have no effect on younger persons.

6. *Secondary.*—Under this head may be included those degenerative changes which take place in morbid formations in the lungs, such as inflammatory deposits, tubercle, or cancer. These belong mainly to the fatty or caseous variety of degeneration, but calcification may also occur.

FREDERICK T. ROBERTS.

LUNGS, Embolism of.—*See* LUNGS, Anæmia of; and LUNGS, Hæmorrhage into.

LUNGS, Emphysema of.—SYNON.: Fr. *Emphysème du poumon*; Ger. *Lungenemphysem.*

DEFINITION.—An excess of air in the lungs, whether due to a dilated condition of the air-sacs, or to the presence of air in the interlobular tissue.

VARIETIES.—There are two kinds of emphysema of the lungs, namely :—

A. Vesicular Emphysema.

B. Interlobular Emphysema.

A. **Vesicular Emphysema.**—Pulmonary vesicular emphysema exists in three forms, namely, 1. *partial lobular*; 2. *lobular*; and 3. *lobar.* The last form involves the whole of a lobe, or the whole of one or both lungs. The first form is rarely seen alone, but is generally associated with the second form, which is very common, and is found in connection with diseases, such as bronchitis, which are attended with violent or long-standing cough. The third form is by far the most important, and will be more especially referred to in the present article. It more frequently attacks both lungs than one, and the lower as well as the upper lobes. It is a serious malady, and sometimes destroys life at an early period. Its features are characteristic : the lung-substance has a peculiar doughy feel; pits on pressure ; is wanting in healthy crepitation ; and has a colour very closely resembling that of a calf's lung. It has been described as 'large-lunged vesicular emphysema.'

ÆTIOLOGY.—*Determining causes and mechanism.*—With reference to the determining causes of emphysema there are two theories, namely, the inspiratory theory, and the expiratory theory. On the first view the dilatation and rupture of the air-sacs are accounted for by the over-distension of the lungs in inspiration. On the second view these changes are considered to be caused by the strain to which the lung-tissue is subjected in violent expiratory efforts, especially the act of coughing. It has been thought by others that emphysema must be looked upon as a complemental lesion, arising in consequence of the over-distension to which the healthy portions of the lungs are subjected in cases of pulmonary collapse. Without entering into any critical examination of the theories as to the mechanical causes of emphysema, it may perhaps be sufficient to say that there can be little, if any, doubt that the lobular forms of the disease are mainly produced by expiratory efforts, such as violent cough, or blowing wind instruments. They have their seat in those parts of the lungs which become most distended by such acts. With regard to the lobar form of the disease, however, this explanation of its mechanism does not suffice. In this affection the inspiratory power is that which distends the lungs. The pulmonary tissue has lost a portion of its elasticity, it yields to distension, and no longer re-acts perfectly when the distending power ceases. Further distension follows ; reaction diminishes still more ; until at length in some instances the lungs become greatly enlarged.

In senile cases the loss of elasticity of the chest-walls aids in preventing the pulmonary reaction.

ANATOMICAL CHARACTERS AND PATHOLOGY.—In the early stages of emphysema there is simply a dilatation of the air-sacs; an increase in the size of the alveoli; and a diminution in the height of the alveolar walls, which yielding with the distending cavities, become partially

obliterated. As the disease progresses the air-sacs become more distended, and the walls of the alveoli sometimes completely obliterated, so that the air-sacs are quite smooth, instead of honeycombed. Then follows perforation of the air-sacs—at first slight, here and there an oval opening being discoverable; afterwards the openings become more numerous and larger. The subsequent progress of the disease is attended with further distension of the air-sacs, and rupture of the fibres of their walls. The openings thus caused coalesce, until at length the walls are simply represented by membranous shreds, and even large vesicles may form. These changes, varying in degree, characterise all the forms of emphysema. In the lobar form, however, perforation takes place to a much greater extent *quoad* the amount of dilatation, than in the lobular or partial lobular form.

The emphysematous lung is anæmic, its blood-vessels become widely separated, and often ruptured and atrophied. The bronchial tubes are sometimes dilated, especially in old-standing cases, and in these there is frequently found an increased development of the circular muscular fibres.

The pathology of emphysema involves some important points for consideration. The great question is whether there is any degeneration of tissue preceding or attending the affection. When the disease is partial, and has followed or is attended by bronchitis, or some other affection in which there has been violent or long-standing cough, the emphysema may be the result of mechanical violence, without pre-existing degeneration of the lung-tissue. When, however, it is of the lobar form, degeneration is probably the primary step in the affection. The facts which tend to confirm this view are:—(1) the insidious manner in which the disease sometimes comes on, and the development which it attains, without any previous history of violent or long-standing cough; (2) the frequency with which it attacks the whole of both lungs; and (3) its hereditary character. The exact nature of the degeneration has not been satisfactorily made out. Fatty matter has been found in a few instances, but not in all cases. The degeneration is probably one primarily involving the elastic fibres and other structures of the walls of the air-sacs. Whatever be the nature of the degeneration, there can be no doubt that lobar emphysema is a malady resulting from some form of mal-nutrition of the lung-tissue. There is reason to believe too that this form of emphysema is sometimes associated with gout.

There is a form of lobar emphysema which is met with in old age, and which differs in some respects from that already described. The lungs are not so large; they are universally distended, however, to a greater or less extent; and they present a somewhat atrophied appearance. The alterations, of which they are the seat, are probably the result of those changes which age produces in the chest-walls, impairing their elasticity. This loss of elasticity may also affect the lung-tissue. *See* LUNGS, Atrophy of.

A knowledge of the changes produced by emphysema affords an explanation of the peculiar character of the respiratory movements and sounds, as well as of the other physical signs and symptoms of the disease. The lungs being the seat of general expansion, the thorax is kept abnormally distended. Thus it can undergo but little enlargement at each inspiration. As there is no impediment to the passage of air to the air-sacs, inspiration is accomplished rapidly. Not so, however, with expiration. The lung-tissue has in great measure lost its elasticity, and reacts slowly after distension; and this results in laboured, slow, and ineffectual efforts to expel the air. Further, as the lungs are more or less riddled with perforations, their aërating surface is diminished, and this necessarily causes dyspnœa, whenever any increased demand is made on the respiratory function. The quantity of blood circulating through the lungs, even from the earliest stages of the affection, is also diminished; and the destruction of the capillary vessels, which ensues when the disease is more developed, further decreases the vascularity of the pulmonary tissue. Hence its pale, anæmic appearance after death, a circumstance which serves to explain how rarely it is the seat of pneumonic inflammation.

SYMPTOMS.—A constant and generally gradually increasing dyspnœa is one of the most important and most frequent of the symptoms of emphysema. Cough with expectoration is generally more or less present. Hæmoptysis is rare, and when it does occur, is slight. The patient usually complains of no pain, but of a feeling of oppression, or a 'smothering in the chest.' In severe cases of lobar emphysema this last symptom and the dyspnœa are often the only circumstances which attract the attention of the sufferer to his malady. In other instances, however, and especially when the disease is only partial, a close examination will elicit the fact that there have been bronchitic symptoms. Few cases of emphysema exist for any length of time without the occurrence of asthmatic seizures. In advanced cases the aspect is peculiar. The countenance is dusky, leaden, and puffy. The nostrils are dilated, and expand widely on inspiration, whilst the angles of the mouth are drawn down. The voice is feeble. The whole body has a cachectic appearance, and is sometimes much wasted. General dropsy often ensues.

PHYSICAL SIGNS.—Amongst the most important of the physical signs of emphysema are the following:—The upper part of the chest and the clavicles are prominent; the neck seems shortened; the fossæ above the clavicles are deepened; there is increased curvature of the dorsal spine; and the sternum is arched. The gait is stooping; the ribs are prominent; and the intercostal spaces are depressed. There is indeed a general increase in the size of the chest, usually most marked at the upper part. These are the features of the disease when it is extensive. If partial, or confined to one lung or part of a lung, the prominence of the chest exists on one side only, and the other symptoms and signs are less marked. The movements of the chest in respiration are peculiar. The breathing is for the most part superior thoracic, but the chest is not much expanded on inspiration, for the lungs are already inordinately distended. The lower end of the sternum and the lower ribs are drawn in

during inspiration. In some cases during inspiration there is marked protrusion of the abdomen. The respiration presents other features. The inspiration is short and quick, and is followed by a prolonged and often wheezing expiration. Coughing is performed feebly, and expectoration is attended with difficulty. Percussion and auscultation elicit important diagnostic marks of the disease. When it is general there is increased, and in some instances almost tympanitic, resonance over the whole of the chest, most marked towards the apices of the lungs, and along their anterior borders; and in partial cases almost confined to these spots, or to one side. The præcordial region is generally resonant, owing to the distended lungs coming between the heart and the wall of the chest; and the cardiac impulse can often be felt beneath the lower end of the sternum. The respiratory murmur is faint, and characterised by peculiarities which a knowledge of the anatomical condition of the lungs and of the chest-walls enables us to explain. The inspiratory murmur is short, and is followed by a prolonged expiratory murmur. This latter is unlike the sound heard in any other affection, and is, in fact, pathognomonic of emphysema. In some advanced cases the respiratory sounds are scarcely audible, if the bronchial tubes are free from mucus, and no spasm exist. Laennec described a *râle* which he thought was peculiar to emphysema. He called it 'râle crepitant sec à grosses bulles.' A *râle* such as Laennec described is often heard in emphysema, but it is not a dry *râle*. It is probably produced in the finest bronchial tubes, and is a modification of the subcrepitant *râle* of bronchitis. Although valuable in aiding diagnosis when present, yet from its frequent absence and the difficulty of distinguishing it from the ordinary sup-crepitant *râle*, it loses much of its diagnostic import.

Complications and Sequelæ.—Bronchitis is one of the most frequent of the diseases associated with emphysema of the lungs. It is rare for the latter affection to exist for any length of time without the supervention of the former. Bronchitis presents some peculiarities when it affects an emphysematous lung. It is rather the result of congestion than of inflammation. It often attacks the finer bronchial tubes; and when severe, is attended with profuse secretion; a circumstance which, coupled with the fact that expectoration is less easily accomplished than when the lungs are healthy, seriously complicates the affection, and increases the danger of death from apnœa. The inflammation sometimes runs on very rapidly, and copious purulent or puriform expectoration occurs. Even when this is the case, an examination of the tubes after death may reveal but little vascularity of the mucous membrane. These severe bronchitic attacks are very apt to be attended by the formation of fibrinous clots in the heart and the large vessels arising therefrom. Bronchitis, in a sub-acute or chronic form, is a very constant cause of winter cough in emphysematous patients.

Asthma, occurring with greater or less severity, is a frequent attendant on emphysema. The attacks come on for the most part during the night, and may possibly be due to the congestion of the lungs which takes place during sleep, or when the body is long in the recumbent posture. This congestion probably sets up an irritation, which gives rise to reflex spasm of the bronchial muscular fibres.

Secondary affections of the heart are constantly met with in advanced cases of emphysema. Many pathologists have believed that the right cavities alone become affected; but more recent observations have shown that the cardiac disease is not confined to one side. There is, in extensive emphysema, a general hypertrophy of the heart, with dilatation of all the cavities, especially of the ventricles. But hypertrophy is not the only change which takes place; valvular disease is frequently found. The deposits and thickening which occur about the valves are no doubt secondary to the changes in the muscular walls, and must be attributed to the general mal-nutrition produced by the disease. It is not difficult to understand how it happens that in emphysema there is general cardiac hypertrophy. The impediment which exists to the circulation of the blood through the lungs necessarily gives rise to an overloaded state of the right side of the heart; hence results increased action of the right cavities, and hypertrophy of their walls. Again, the overloaded state of the venous system, and the consequent impediment to the capillary and arterial circulation, call for increased action of the left ventricle; and this is followed by its dilatation and thickening. There exists also another cause, which probably has some influence in producing this cardiac hypertrophy, namely, the altered position of the heart. This organ is pushed downwards and towards the median line, and its impulse is often felt strongly in the epigastrium. The position of the ventricles is therefore changed, and the direction of the axis of their cavities is altered with reference to that of their great vessels. This must lead to embarrassment of the circulation.

As a consequence of the changes in the heart and venous system in emphysema, dropsy often results. Many cases go on for a long time without any dropsical symptoms, whilst in others there is only slight œdema of the legs. In advanced cases, however, there is frequently general dropsy.

General emphysema is attended in its progress with symptoms of cachexia and anæmia. In some cases there is much wasting of the muscular system, even before dropsical effusions occur. Further, the patients often have a sallow and anæmic appearance, not unlike that met with in renal and other serious organic diseases. There has been an impression that emphysema and phthisis are incompatible diseases, but recent researches have shown that this view is not correct. Indeed, in a large proportion of cases of death from phthisis, patches of emphysema, lobular or partial lobular, are met with; and doubtless have been produced by the fits of coughing so common in the disease. But the great question is whether tubercular deposit ever takes place in lungs which are the seat of lobar emphysema; and this question must be answered in the affirmative, although the concurrence of the two diseases is rare. Pneumonic consolidation is very uncommon in an

emphysematous lung, and probably acute so-called sthenic pneumonia never attacks the organ in such a condition.

Pleurisy not unfrequently exists in connection with emphysema; pleuritic adhesions being often found after death. The occurrence of pleurisy must, however, be considered as an accidental circumstance. In the most extensive cases of emphysema pleuritic adhesions may not be found.

TREATMENT.—This must be referred to under two heads, namely (1) the treatment of *the disease*; and (2) that of *the secondary affections*, which follow or are associated with it.

(1) *Treatment of the disease.*—Too little attention has been paid to emphysema of the lungs as a substantive disease. Considered in the main as the result of bronchitic affections, the treatment has been chiefly directed to the control of these attacks; and in regard to the partial forms of emphysema, this is a most important object. But in reference to lobar emphysema, if we recognise the fact that it is primarily due to some degeneration of tissue, it is obvious that the treatment should be directed to check, if possible, this process. It can scarcely be expected that when once perforation and rupture of the air-sacs have taken place, the normal condition of the lung can be restored. But whilst we admit this, it is by no means implied that the disease is beyond control. That condition of lung-tissue which precedes the perforations—the simple distension of the air-sacs—admits of great amelioration, and further degenerative changes may be, if not prevented, at least much retarded.

The main principles of treatment should be such as guide us in the management of other constitutional diseases attended with degeneration. All measures which tend to invigorate the system, to give tone to the heart, and improve the condition of the blood, should be resorted to. Amongst the remedies for internal administration the most useful is iron. It should be given in small and continued doses. Quinine is valuable, as are also the various bitters and other remedies for dyspepsia, from which emphysematous patients often suffer. Cod-liver oil is very useful in some cases. Strychnia has been recommended with the view of improving the tone of the muscular fibres of the bronchial tubes. It has not been found useful in this respect; nor need we wonder at this, for the disease is one primarily of the air-sacs, and not of the bronchial tubes, and if the muscles of the latter are secondarily affected, it is rather with spasm than paralysis. Small doses of strychnia given for dyspeptic symptoms may be useful.

Breathing condensed air has been strongly advocated, and no doubt it has afforded in some cases decided temporary relief, but no permanently good effects have apparently ever followed its use. *See* AIR, Therapeutics of.

The regulation of the diet, and the general management are most important. The diet should be nourishing, and a moderate amount of stimulants should be allowed. The food should be easy of digestion, and nutritious in proportion to its bulk. The stomach should never be overloaded, as that condition will give rise to dyspnœa. Errors of diet must be avoided, and the functions of the bowels should be carefully regulated. Another point is to give the lungs as little work as possible, and to let the patient breathe a pure air. All violent exercise, or physical exertion of any kind, must be strictly prohibited; moderate exercise is, however, to be recommended. Moderate walking, yachting, carriage exercise, riding at a quiet pace, and on an easy horse, are important adjuvants in the general treatment of emphysema. The condition of the skin should be carefully looked to; warm clothing should be constantly worn; and the greatest care should be taken to ward off bronchial inflammation. Residence during the winter in a warm and dry climate is to be recommended.

2. *Treatment of secondary affections.*—Amongst the most important of the affections secondary to emphysema is bronchitis. No depressing measures should be used in this disease, but such as will promote expectoration, and check the secretion of the bronchial tubes, if, as is very frequently the case, this be excessive. Ammonia, the various stimulating expectorants, and iron are the most valuable remedies, together with moderate counter-irritation (*see* BRONCHI, Diseases of). The dyspnœa attendant on emphysema admits only of palliative treatment, but is often greatly improved by the observance of the rules laid down for the general management of the disease. The dyspnœa is always increased by the presence of bronchitis; by the stomach or bowels being overloaded; and by the general over-distension of the venous system, which necessarily ensues as a consequence of the impediment to the flow of blood through the lungs. Care should be taken to prevent any flatulent distension of the stomach or intestines, and to keep up a good action of the bowels, liver, and kidneys. For the relief of the asthma which frequently exists in connection with emphysema, full doses of iodide of potassium are often useful. Stramonium may also be smoked, and other measures beneficial in ordinary spasmodic asthma may be tried (*see* ASTHMA). In reference to the treatment of the dropsical symptoms, which follow as a secondary consequence of emphysema, the reader is referred to the article DROPSY.

B. **Interlobular Emphysema.**—This condition, in which the excess of air in the lungs is contained not in the alveoli but in the connective tissue between the lobules, is described under the head of EMPHYSEMA, SUBCUTANEOUS.

A. T. H. WATERS.

LUNGS, Gangrene of.—SYNON.: Fr. *Gangrène du Poumon*; Ger. *Lungenbrand.*

DEFINITION.—Death of a portion of the substance of the lungs.

Gangrene of the lungs is of two kinds, namely: (1) *diffused*, in which the whole of one lobe or lung is affected; and (2) *circumscribed*, in which a portion only of a lobe undergoes gangrenous change.

ÆTIOLOGY.—Gangrene is sometimes a result of acute pneumonia. It has been known to follow the inhalation of noxious gases. When it occurs independently of these causes, it is an evidence either of extreme constitutional depres-

sion, or of pressure interfering with the circulation and nutrition of the lung. An aneurism or mediastinal growth, pressing upon the main arterial, venous, and nervous trunks at the root of the lung, is perhaps the most common cause of diffused gangrene; whereas the more circumscribed form of the disease is a sequela of acute and limited pneumonia, cancer, or rapid phthisis in a debilitated subject. In pulmonary apoplexy gangrenous change sometimes occurs, the gangrene being limited to the portion of lung involved in the originating extravasation of blood. Pneumonia caused by a foreign body in the air-passages is apt to run on to gangrene. The diffused gangrene that occurs in drunkards and lunatics, in asthenic fever, measles, small-pox, and typhus, evidences excessive nerve-prostration and loss of nutritive power. In children gangrene of lung sometimes follows cancrum oris, as well as the eruptive fevers.

Anatomical Characters.—The colour of a gangrenous lung is dark, dirty olive, or greenish brown. It is moist or wet; and either of the consistence of engorged lung, or softer and more diffluent. The odour is that of external gangrene or decomposed flesh, and is distinctive during life, rendering the room in which the patient lies horribly offensive. When scattered patches of gangrene occur, there is often in one part a solid mass of greenish lung-tissue, and in another a central sloughy or gangrenous cavity, surrounded by a broad rim of soft, infiltrated lung. The seat of circumscribed gangrene is usually the periphery of the lung, and the lower lobes. If a bronchus open into the gangrenous patch, inflammation of the bronchial membrane is set up. In rare cases the pleura is involved, and pyo-pneumothorax induced. Sometimes the pulmonary arteries are found plugged, and more often the bronchial arteries. In those rare cases in which recovery takes place interstitial pneumonia is set up, leading to encapsulation of the gangrenous spot; the sloughs are ejected; and cicatrisation follows, as in pulmonary abscess.

In diffuse gangrene the whole of one lung is sometimes involved. The pulmonary tissue is then converted into a black, putrid substance, saturated with blackish purulent fluid; or the gangrenous part merges gradually into œdematous or hepatised tissue.

Embolism, arising from the introduction of putrid matter into the veins, and leading to abscess in various organs, may follow either form of gangrene. Secondary gangrenous change is frequently met with in other parts of the same or of the opposite lung.

Symptoms.—It is seldom possible to diagnose gangrene of the lung until the purulent discharge reaches a bronchus and is ejected. Then the sputa are found to soon separate into layers—a frothy superficial one, a liquid middle, and a lower sediment. The smell of the sputa and breath is pathognomonic. The dyspnœa and prostration are usually great. The physical signs are those of softening and excavation, percussion being either dull or tympanitic, and loose crepitation being soon replaced by gurgling and perhaps amphoric breathing. The passage of the circumscribed into the diffused form may be traced by watching the physical signs.

Diagnosis. — Suppurative ulceration of the bronchial cartilages gives rise to great fœtor of breath. Sometimes a gangrenous odour in the breath occurs when the putrefactive change is limited to the secretions, the lungs being free; and it is present also in pyo-pneumothorax with internal fistula. These several diseases must be excluded by a careful estimation of the history and the physical signs.

Prognosis. — The prognosis of pulmonary gangrene is hopeless in the diffused form; and should be made very cautiously, even when the symptoms or signs point to a limitation of the mischief.

Treatment.—Besides the general treatment which co-existing disease may require, special attention must be given to the removal of the gangrenous odour from the atmosphere of the room, from the sputa, and from the patient, who is apt to exhale from the skin a similar odour to that given off in the breath. Sulphurous acid, carbolic acid, or chloride of lime fulfil the first indication; Condy's fluid the second; and this may also, when diluted, form a useful wash, gargle, or drink. The sulpho-carbolates, when administered freely, have a distinct value in removing the fœtor from the skin, and making the patient less unapproachable.

When a gangrenous abscess of the lung exists, and it is evident that the passage of fœtid matters through the bronchi is setting up dangerous irritation, leading to exhausting discharge, or threatening to poison the system, the question of tapping the gangrenous cavity should be entertained. The introduction of a drainage-tube sometimes affords immediate relief in such cases; the fœtor of breath ceases; the offensive secretions, being no longer locked up in the lung, lose their putrescent character; and the relief to the constitution is great. An accurate diagnosis is in such cases essential, the danger of the operation being greatly enhanced if the abscess is at a distance from the chest-wall, and if the lung is not adherent to the costal pleura. The operation should only be performed when there is but little prospect of recovery without it, but must not be delayed until the vital powers are too reduced to allow of ultimate convalescence.

Every attempt must be made to support the strength by nourishing food and stimulants; bark and ammonia, quinine and acids, iron and cod-liver oil being indicated. The inhalation of creasote or carbolic acid in spray may be tried, or of turpentine given off from hot water.

E. Symes Thompson.

LUNGS, Hæmorrhage into.—Synon.: Extravasation of blood into the lungs; Pulmonary apoplexy; Fr. *Hémorrhagie du poumon*; Ger. *Lungenblutung*.

Ætiology and Pathology.—In the article Hæmoptysis will be found enumerated the causes which lead to pulmonary hæmorrhage. In the present article only those extravasations of blood into the lungs are included which do not depend upon direct injury to the organ, or upon exposure and rupture of vessels in the course of destructive disease affecting it. Hæmorrhage into the substance of the lungs may be *diffuse*, *punctiform*, or *circumscribed*.

(1) *Diffuse pulmonary apoplexy.*—The diffuse extravasation of blood into the lungs is an extremely rare condition. Some cases have been recorded, however, in which it has arisen from primary disease of a branch of the pulmonary artery. The lung-tissue is broken down by the hæmorrhage into it; and the patient soon succumbs.

(2) *Punctiform hæmorrhage*, and (3) *circumscribed* or *nodular pulmonary apoplexy*, are not of uncommon occurrence, and are attendant upon the same morbid conditions of the lung. Mitral disease of the heart, mitral stenosis especially, but also mitral regurgitation, are the chief remote causes of these two forms of pulmonary apoplexy.

In certain purpuric states of system, which we need not here specify, punctiform hæmorrhage in the lungs is possible; the purpura much more frequently affects, however, the pleural surface or bronchial mucous membrane. Mechanical congestion of the lungs from the above-mentioned forms of heart-disease is by far the most common condition upon which this minute and interstitial form of hæmorrhage supervenes, giving rise to no additional symptoms, but causing considerable and peculiar pigmentation of the lung. The interstitially thickened lungs acquire a brownish tint, from the absorption of the blood-spots, leaving hæmatin behind, and the appearance has given rise to the term *brown induration* of the lungs. *See* Lungs, Brown Induration of.

Nodular or circumscribed pulmonary apoplexy is often associated with the petechial hæmorrhage just described, and like it mostly supervenes upon the mechanical congestion of the lungs arising from heart-disease. There are two ways in which this form of hæmorrhage may be produced. The first way is by rupture of capillaries or small veins under the heightened pressure of the pulmonary circulation. An effusion of blood thus occurs, which fills up one or more lobules, and coagulates to form the dark firm consolidations so characteristic of the lesion. Or a branch of the pulmonary artery becomes obstructed by an embolus, for instance, by a fragment of coagulum conveyed from the right auricle, or from one of the systemic veins; and its territory becomes at once filled with blood, in the following manner. The pulmonary arterial vessels do not communicate with one another, each branching separately to its capillary distribution; the pulmonary veins, on the contrary, inosculate freely, and, moreover, are not provided with valves. Thus when the onflow of blood is arrested through the obstructed branch, venous regurgitation through the capillaries from collateral pressure fills up the precluded vascular area with stagnating blood, and the intra-alveolar tissues become speedily occupied with its effused corpuscles. In some cases the vessel may not at first be accurately closed by the embolus; the onward current is then retarded instead of being quite arrested; the mechanism is, however, practically the same.

Anatomical Characters.—A lung, the seat of this form of hæmorrhage, is usually toughened and heavy. Some hard, and more or less square, flat surfaces may be felt and seen raised above the general surface of the lung, which has shrunk below their level. The pleura covering such patches is darkened in colour, and presents flakes or granulations of lymph, impairing its translucency and smoothness. On making a vertical section through one of the surfaces, it is found to form the base of a more or less conical mass, which has a firm damson-cheese-like section, and is sharply defined from the surrounding tissue. In its axis is seen a branch of the pulmonary artery, occupied by partially altered clot. There is usually some staining of the pulmonary tissue immediately surrounding the apoplectic nodule, from imbibition. Such hæmorrhagic nodules vary greatly in number and size; there are usually several in each lung, of about the size of a walnut; but one may occupy a whole lobe. They also vary in appearance according to the date of their occurrence; their colour, at first that of dark blood-clot, passes through pale chocolate or catechu tint to yellowish red or pale yellow, as the colouring matter becomes gradually absorbed. The whole extravasation may be gradually and completely absorbed, leaving the restored lung but little damaged; or a shrunken fibrinous deposition or blood-cyst, with surrounding induration, may mark the site of former hæmorrhage. It should be added that these extrasavations, although generally near the pleural surface of the lung, are not always so, but may occur deeply in its substance.

Symptoms.—Amidst the distressing symptoms which are attendant upon the conditions leading to pulmonary apoplexy, it would be difficult to single out any diagnostic of this special lesion. An exacerbation of dyspnœa already terrible enough, or a sudden failure of pulse, may perhaps be noted. Dark scanty hæmoptysis is, however, the pathognomonic sign, the frothy mucous expectoration containing some streaks, or small clots of dark coagulated blood. Some circumscribed patches of dulness, with bronchial breathing and neighbouring crepitation, may be made out, especially in the mammary and mid-axillary regions.

Prognosis and Treatment.—These lesions are among those which close the scene in the heart-disease to which they are accessory; they are therefore irremediable. Sometimes when, from any cause, their occurrence appears to have been hurried forward; when the lividity is great, the dyspnœa urgent, and yet the disease is not of long duration; wet-cupping or bleeding from the arm will certainly give great temporary relief, and perhaps avert immediate danger.

R. Douglas Powell.

LUNGS, Hydatids of.—Synon.: Fr. *Kystes hydatiques du poumon*; Ger. *Lungenechinococcus.*

Definition.—A disease due to the presence of hydatids in the lungs.

Ætiology.—Hydatid cysts in the lungs rarely occur in this country as a primary disease of the lung, but they are not unfrequently met with as an extension of disease from the liver.

The general causes of hydatid disease are elsewhere discussed, but the circumstances which determine the localisation of the hydatid are not clearly ascertained. In Australia, where the affection is very common, it is met with

sometimes in the lung without any other organs being affected; although in many cases in which the lungs are diseased, evidence of the existence of the same disorder elsewhere is not wanting. In 100 cases, the liver was the organ affected in 70, the lung in 12. The great prevalence of the disease in Melbourne is said to be due to drinking from water-holes frequented by sheep, and from eating watercress or uncooked salads containing the ova of the parasite.

Anatomical Characters.—The general anatomy of hydatid disease will be found in the article describing this parasite (*see* Hydatids). Single sacs of acephalocysts are by far most usual, varying in size from a pigeon's egg to a man's fist. Sometimes the upper, and sometimes the lower lobes are the seat of the cysts. They are developed in the interstitial pulmonary tissue; as growth proceeds, the neighbouring parenchyma is converted into fibro-cellular tissue, and undergoes obsolescence. The parent sac, containing the echinococci, is adherent to the surrounding tissue.

If the parent sac be destroyed by inflammation and consequent suppuration, a communication is established between the cavity and the bronchi, through which the daughter-cysts may be ejected; just as in more common instances they may escape from the liver after perforating the diaphragm and lung. Not unfrequently the pulmonary sac communicates with a similar sac in the liver. It is natural to infer in such cases that the disease originated in the liver. Indeed, it has been stated that primary hydatid of the lung is unknown.

Symptoms and Physical Signs.—Hydatids may exist in the lung for a considerable time without giving rise to any noticeable symptoms; but as the tumour enlarges, and presses upon the surrounding tissues, hæmoptysis occurs, as also bronchitis, pneumonia, or even gangrene. Sometimes the cysts perforate the pleura and cause pneumothorax, or make their way through the diaphragm into the abdominal cavity. The more usual course is the converse of this, namely, that a hydatid of the liver exists perhaps for years, causes abdominal distension, and eventually discharges its contents through the diaphragm into a bronchus; then expectoration of blood occurs, with gooseberry-like skins, varying in size from a nut (in which case the cyst may be expelled whole) to an orange (in which case the sacs are shrivelled and empty), causing strangling and suffocating cough during expulsion.

If the site of the tumour be superficial, altered breath-sounds and percussion-note may be observed, but if it be deeply seated, the physical signs may escape detection. If bronchitis or pneumonia be set up, the signs and symptoms of these disorders mask those of the originating disease. Often the symptoms are like those of rapid phthisis, namely, cough, muco-purulent expectoration, hæmoptysis, night-sweats, and emaciation. The meaning of these symptoms is apparently confirmed by the physical signs, namely, dulness on percussion; absence of breath-sounds, or prolonged expiratory murmur; and, when the cysts burst, gurgling and pectoriloquy. Unless the daughter-cysts or hooklets are expectorated, there is nothing to point unmistakeably to the nature of the disease. When perforation of the diaphragm occurs, hepatic symptoms or those of pleurisy occur. The patient looks anxious; the features are collapsed; the skin is clammy and livid; the extremities are cold: incessant paroxysmal cough occurs, with vomiting; and by degrees sallowness and jaundice make their appearance. Symptoms of acute pneumonia may occur—of consolidation, followed by excavation; the expectoration being at first rusty, then bile-tinged, muco-purulent, and fœtid, and containing, besides shreds of lung-tissue, entire cysts or portions of them.

Diagnosis.—It may be difficult to distinguish a large hydatid cyst from pleuritic effusion, as the lung may be displaced, the chest bulges, and the intercostal spaces become prominent and fluctuating. The rounded outline of the dull space, the absence of acute symptoms, the history of gradual onset, the absence of ægophony, and of alteration of physical signs on change of posture, will guide the decision; and an exploratory puncture, which gives exit to a clear saline, non-albuminous fluid, containing possibly hooklets or fragments of cysts, will confirm the diagnosis. The conduction of the heart-sounds and impulse, and the tense unyielding condition of the bulged side on palpation, may lead to the suspicion of mediastinal tumour; but in the case of hydatids there is seldom any visible venous engorgement, or laryngeal or œsophageal pressure-sign, as in aneurismal or other mediastinal growths. There is, moreover, generally a freedom from cachexia or constitutional disturbance. In circumscribed abscess the neighbouring lung is rarely so free from disease as in hydatid.

Prognosis.—Although the symptoms may be so severe as to threaten immediate death from suffocation, recovery occurs in at least half the cases in which hydatid disease begins in the lung, and one-third of those in which it spreads from the liver, If the cyst is allowed to burst of itself, recovery takes place in from 30 to 40 per cent. of cases. But the mortality is greatly reduced by early tapping.

Treatment.—Palliative treatment must be directed mainly to the mitigation of pain, and other urgent symptoms. Curative treatment consists in destroying the vitality of the cyst. If the fluid contents are drawn off, or allowed to escape, the death of the hydatid may occur, or inflammatory action, leading to suppuration. If the fluid re-collect and pressure-signs recur, iodine or other stimulating fluid may be injected. The iodide or bromide of potassium with kamela have gained among Australian physicians reputation in these cases, especially when combined with the use of the trochar.

E. Symes Thompson.

LUNGS, Hyperæmia of.—Synon.: Congestion of the Lungs; Fr. *Hypérèmie du poumon*; Ger. *Lungenhyperämie.*

Definition.—Excess of blood in the lungs, whether local or general.

Varieties.—Pulmonary hyperæmia may be **active, passive, or obstructive.**

The morbid appearances and symptoms are different in these three kinds of hyperæmia, and they may, therefore, be best considered separately.

A. **Active Hyperæmia of the Lungs.**—Synon.: Active congestion; active affluxion.

Definition.—A determination of blood to the lungs.

Anatomical Characters.—Active hyperæmia or congestion may affect any portion of the lung, which remains crepitant and little changed, save that it is more crimson in colour, and contains slightly more blood than natural. The condition is indeed rather a vital or physiological one; and, as in active hyperæmia of the skin, may present no *post-mortem* appearances. On section, however, the lung usually exudes some frothy serum, tinged with blood; and sometimes, especially when the hyperæmia is local and arises from collateral stress of circulation, there is found hæmorrhage into the lung. The mucous membrane of the bronchial tubes is minutely injected, or it may be quite natural in appearance.

Ætiology.—The causes which produce inflammation of the lung will also produce active hyperæmia, namely, cold, irritation, adjacent inflammation, &c. Increased action of the heart during violent effort or excitement, whether from mental emotion or from drink, will produce the same effect. It is said that the pressure of blood in the pulmonary artery increases more rapidly than that in the aorta during exertion (Colin). Hæmoptysis from pulmonary hyperæmia is commonly produced by the excessive imbibition of stimulants. Predisposition, either hereditary or in consequence of present disease, renders these last-named causes much more readily operative. Obstruction to the passage of blood through one portion of the pulmonary system of vessels, for example, by embolism, or by destruction of capillaries, will cause increased collateral activity of circulation. Sudden suppression of menstruation may cause active determination of blood to the lungs. Sudden diminution of the atmospheric pressure within the chest, as during violent inspiratory effort, whilst the trachea is closed, for instance, in croup, laryngismus, or whooping-cough, may cause active determination of blood to the lungs.

Effects.—Several important effects may be produced by active hyperæmia of the lungs. Hæmorrhage is rarely extensive, unless there be attendant organic lesion present. Active hyperæmia of the lung constitutes the first stage of exudative or croupous pneumonia, with fibrinous exudation into the air-cells. Pulmonary œdema may result from the excessive blood-pressure, the serum exuded being frothy and blood-tinged. Vesicular catarrh is not so distinctly a consequence of hyperæmia, with which, however, it is often associated.

Symptoms.—The symptoms of active pulmonary hyperæmia are dyspnœa; more or less pyrexia; cough; and sometimes copious hæmoptysis, in which case precedent organic disease must be suspected. The rusty sputa of the first stage of pneumonia is that most typical of pulmonary hyperæmia.

Diagnosis.—The diagnosis would rest mainly upon the suddenness of attack, and the evidence of a sufficient determining cause, with or without predisposition.

Prognosis.—Active hyperæmia, save in some cases of collateral afflux, is necessarily a transient affection, subsiding in a few hours, or passing on to inflammation.

Treatment.—The first point in the treatment of this condition is to secure absolute rest in bed, with silence, and removal of all causes of excitement. Derivatives; mustard or linseed poultices to the chest; perhaps cupping, or even blood-letting; warmth to the extremities; saline purgatives; and a low diet, without stimulants, may all be employed. The special cause of the hyperæmia should be treated. As a rule astringent medicines should be avoided. Digitalis is useful to calm the circulation, especially after excitement from alcohol. If the pyrexia be very marked, pneumonia may be expected, and saline diaphoretics are especially indicated.

B. **Passive Hyperæmia of the Lungs.**—Synon.: Passive or hypostatic congestion.

Definition. — An incomplete stagnation of blood in the lungs.

Ætiology.—Passive or hypostatic congestion of the lung is a condition of hyperæmia affecting by preference the most depending parts of the lung. Failure of heart-power, an inability to propel the blood clear through the pulmonary capillaries, is the chief cause of this condition. In states of exhaustion from low fevers, especially typhus and typhoid; after severe surgical operations; in extreme old age; or towards the end of prostrating illness, this failure of heart-power, and consequent stagnation of blood in the lower parts of the lung, usually the bases, is apt to supervene, and is one of the common modes of death. An altered condition of the blood, so as to render its passage through the capillaries more difficult, is also stated to be a cause of this form of congestion of the lungs and of other organs. In uræmic and icteric conditions, and in the febrile state, the blood does not pass through the capillaries with the same facility as in health, and hypostatic congestions are more apt to occur. Finally, when the vessels have lost their tone, and the heart fails in power, gravitation exercises its influence in attracting the blood to the most dependent parts.

Anatomical Characters.—Passive hyperæmia almost always affects the bases of both lungs, although often not in an equal degree, the difference depending mainly upon the position of the patient during the last days of life. The affected lung is dark-coloured, and engorged with dark blood. Its tissue is more or less deeply stained with blood, and is less crepitant than natural, yielding also more readily than natural under the pressure of the finger. If thoroughly washed, however, in a gentle stream of water, the lung-texture will be found to be but little altered. This condition very readily passes into a low form of pneumonia, and thus portions of the lung may be found consolidated, having much the appearance and consistence on section of a congested spleen (splenification, hypostatic pneumonia). The bronchial tubes and pleura are affected by *post-mortem* staining.

Symptoms.—The symptoms of this form of congestion of the lungs are lividity, especially of the lips and extremities; and quickened, shallow breathing; superadded to those of extreme prostration. Dulness on percussion, with enfeebled

breathing and moist crepitant *râle*, are found over the bases of both lungs, but in greatest extent on that side to which the patient has been inclining.

Treatment.—Passive hyperæmia of the lungs being never the primary affection, and always being a sign of failing power, its treatment consists in vigorously supporting the patient by alcoholic stimulants frequently administered, with nutritious food. Nutritive enemata are often of great value. In all exhausting diseases this condition should be anticipated, and warded off if possible by timely support and stimulants, and above all by frequently turning the patient from one side to the other, thus calling in the aid, rather than permitting the hindrance, of gravitation to the circulation through the lungs. Of medicines, ammonia, ether, bark and quinine are of the greatest value; and musk, sumbul, and lavender may be useful adjuncts.

C. **Obstructive Hyperæmia of the Lungs.**

Synon.: Mechanical congestion.

Definition.—Hyperæmia from obstruction to the escape of blood from the lungs. Mechanical congestion of the lungs is a condition differing essentially from either of the two preceding.

Ætiology.—The origin of this form of hyperæmia is purely secondary and mechanical, and is included in that of the primary disease. The obstruction may be at the mitral valve, as in mitral stenosis or regurgitation; or, again, the obstruction may be at the left ventricle, when this cavity is dilated and imperfectly emptied, as in the advanced stages of constrictive or regurgitant aortic disease. Whether there be an absolute narrowing of the blood-channel between the pulmonary and systemic circulations, that is, at the mitral orifice or at the commencement of the aorta; or whether, from enlargement of the mitral orifice or from disease or injury of its valve, regurgitation be permitted, so that each contraction of the right ventricle is met and opposed, more or less, by a counter rush of blood from the left ventricle—in any case, and still more in the combination of two or more of these causes, it is clear that the pulmonary circulation can only go on at an increased pressure by the contraction of the right ventricle becoming more vigorous; and that hyperæmia must result from the damming back of the blood through the pulmonary veins.

Of the causes named, mitral constriction is that which leads most simply to obstructive hyperæmia of the lungs.

Anatomical Characters.—It is obvious that obstructive hyperæmia is of general distribution, affecting the whole of both lungs. The result of the heightened blood-pressure from increased force of injection into the lungs, to overcome an impediment to the escape of blood from them, is most felt in the pulmonary capillaries. These capillaries gradually become lengthened, tortuous, and dilated even to three times their normal dimensions (Rindfleisch). From chronic engorgement of the lungs, the nuclei of the interlobular areolar tissue and of the connective tissue surrounding the minute vessels and bronchi, and pervading the parenchyma, proliferate. The thickened and tortuous capillaries intrude upon the air-spaces; and the elasticity of the lungs being also impaired, their vital capacity is diminished. It is stated that the muscular fibres, which proceed from the bronchial terminations to form loops upon and encircle the infundibula, become hypertrophied (Rindfleisch), thus, perhaps, compensating for a diminution in the more mechanical elastic property of the lung. Sometimes minute hæmorrhages take place into the parenchyma of the lung; sometimes larger escapes of blood fill the alveoli of circumscribed patches (pulmonary apoplexy.) The total result of the intimate changes described, is an uniform increase in the size and weight of the lungs, with an increased density and toughness. On section the lungs are found to be more pigmented and solid-looking than natural, sometimes of a brownish hue (brown induration); they are, however, crepitant throughout, except here and there, where they may present the firm, dark, damson-cheese-like section, fading to brown-red, of recent pulmonary apoplexy. There may be some œdema present. The pulmonary arteries and veins are enlarged and congested; and the bronchial mucous membrane is usually the seat of chronic catarrh. Patches of atheroma are frequently to be seen in the larger branches of the pulmonary artery.

Symptoms.—Dyspnœa and cough, both brought on or increased by effort, with palpitation, and oppression or tightness, usually referred to the epigastrium, are the most constant symptoms of obstructive hyperæmia of the lungs. Patients suffering from this condition have repeated attacks of bronchial catarrh, and hæmoptysis is of common occurrence. The hæmoptysis may be considerable, but usually the expectoration is streaked with blood or contains small dark coagula.

This form of hyperæmia commonly occurs before middle life, during the usual period of mitral heart-disease. The signs of heart-disease, and most often of constriction of the mitral valve, are present. The subjects of this disease are often undersized and badly nourished; the pigeon-breasted type of chest being common, especially in those cases in which the disease manifests itself early in life. Small, frequent pulse; more or less lividity of lips; and other signs and symptoms of the cardiac disease, of which the pulmonary condition is the consequence, are to be observed. A fine inspiratory crepitant *râle* over the lungs may be heard. During the repeated bronchial catarrhs, with increased pulmonary hyperæmia, to which such patients are especially prone, all symptoms are much aggravated.

Diagnosis. — The existence of obstructive heart-disease suggests the presence of corresponding hyperæmia of the lungs. The fine crepitant *râle* and the hæmorrhagic symptoms and signs more positively point in the same direction.

Prognosis.—The prognosis rests chiefly upon the heart-condition present. Increasing frequency of catarrhal complications, and especially of hæmoptysis, shows the turning of the balance against the patient. The condition may in favourable cases continue for years, especially when dependent upon simple constriction of the mitral valve.

Treatment.—The treatment is essentially that of the heart-disease; with the avoidance of all causes which hasten respiration, and which tend to produce catarrhs, to which these patients are so especially prone. R. Douglas Powell.

LUNGS, Hypertrophy of.—Definition.—Enlargement of the lungs, with increased functional power. A condition only clinically met with as a compensatory affection of one lung, or of a portion of one lung, to make up for more or less loss of pulmonary tissue by disease.

Ætiology and Pathology.—The process by which hypertrophy of the lung comes about is almost a mechanical one. Destructive disease having removed a large portion of one lung, or permanent collapse or blocking of such portion having occurred from any cause, the diminished power of the affected lung to occupy its apportioned space in the chest-cavity during inspiration, is compensated for by an increased expansion of the healthy lung, together with a certain recession of the softer parts of the chest-wall on the affected side. The increased expansion of the healthy lung encourages an increased afflux of blood, which is at the same time determined through it by the partial obstruction to circulation through the diseased lung. These changes taking place gradually, the increased function and increased afflux of blood are, in accordance with our experience of similar conditions in other parts, attended with increased nutrition of the lung, and its true hypertrophy is thus little by little established.

Hypertrophy of the lung, therefore, is not a diseased condition, but an excessive development in consequence of injury to some other portion of the same or of the opposite lung. Its occurrence may be best noted during the gradual absorption or removal of a pleural effusion, which has long compressed the opposite lung. Any disease, however, which, after destroying or placing in abeyance a certain proportion of one lung, becomes arrested, tends to cause hypertrophous development of the remaining lung. Chronic pneumonia, cirrhosis, arrested phthisis, and atelectasis in the child, are the chief diseases of the kind. While disease is actively progressive the conditions present—namely, fever, anorexia, and pleuritic pains, are unfavourable to the extra development of the sound lung, but when these unfavourable conditions subside, the hypertrophy proceeds with great rapidity, and may be established in a very few months. The effect of the rarefied air of mountainous regions is to develop the natural capacity and function of the lungs.

Anatomical Characters.—An hypertrophied lung is larger and heavier than natural; and its anterior and inferior margins are thick and rounded, and are found to extend beyond their normal thoracic limits both laterally and inferiorly. The texture of the lung is firmer and more resilient than usual; and it is plentifully supplied with blood. The air-cells are slightly enlarged, but not obviously dilated; and on microscopic examination the nutrition of the alveolar walls and capillaries is found to be perfect; there being neither the thinning of the alveoli, nor the excessive growth of fibrous tissue met with at different stages of so-called 'hypertrophous emphysema.' Nor are the capillaries tortuous and dilated as in the indurative 'hypertrophy' of the lung from heart-disease.

Extent of lung affected.—We have considered, for the sake of simplicity of description, those cases in which the whole of one lung is hypertrophied, and such cases are very common. But a single lobe of a lung may become hypertrophied, the seat of the hypertrophy depending upon the seat of the disease to which it is compensatory. But, except when the pulmonary destruction is limited and circumscribed, other conditions come into play, and we are more apt to get emphysema than hypertrophy. It may be said then that hypertrophy of the lung is (at least so far as we can appreciate it clinically) a one-sided affection, except in those cases in which it has been occasioned by some general external cause, as rarefied air.

Physical Signs.—The side on which is the hypertrophied lung is expanded, both relatively (the opposite side being usually flattened and contracted) and absolutely. The nipple-level is raised. There is increased percussion-resonance over the side, extending across the median line, so that sometimes the line of resonance indicating the inner margin of the enlarged lung will reach the mid-clavicular vertical line of the opposite side. The lower limits of resonance are also extended in front and behind. The respiratory murmur has that peculiar coarse vesicular character, with somewhat prolonged expiration, which is known as 'puerile' or 'exaggerated' respiration. The heart is more or less displaced towards the contracted side, and the displacement is often apparently increased by the heart becoming on the one side covered by the expanded lung, and on the other side unduly exposed by the recession of the diseased lung. This is especially the case when the hypertrophy affects the left lung. There are no morbid sounds heard over the enlarged lung unless (as in many cases of phthisis) it becomes or has been affected by disease. With the expansion of the lung the general symptoms improve, and the dyspnœa lessens.

Diagnosis.—The diagnosis has to be made between hypertrophy of the lung; hypertrophous emphysema; and mere dilatation. The unilateralness of the hypertrophy; its arising secondarily to some disablement of the opposite lung; the absence of precedent or present general bronchitis or asthma; together with the observation of its occurrence being commensurate with improvement in the condition of the patient, are the main features distinguishing it from large-lunged or hypertrophous emphysema. Nor could the puerile breathing of hypertrophy be easily confounded with the short, weak, or inaudible inspiration, and wheezy prolonged expiration of emphysema. In persons of broken constitution, with contractile disease of one lung, the opposite lung may become dilated and assume the shape and dimensions of hypertrophy; but the breathing of the patient does not improve, the respiratory sounds are enfeebled, and it is clear that the condition present is one of emphysema rather than true hypertrophy.

Prognosis.—The prognosis is always *pro*

tanto favourable to the patient, the hypertrophy being an important element of his recovery.

Treatment.—Compensatory hypertrophy of the lung is a condition carefully to be encouraged, when all active symptoms attendant upon the original disease are past. Mild courses of calisthenics, and a temporary sojourn at some elevated health-resort during the warm season, are most valuable, if not attempted too soon. Abundance of fresh air throughout the year, with the careful avoidance of fresh catarrhs, such as may be obtained by spending a winter and spring or two seasons at the South of France, in Italy, or at Madeira; or a well-planned sea-voyage to Australia, are excellent ways of spending months of convalescence. A generous unstimulating diet is indicated, and tonic remedies and cod-liver oil are useful, more especially in the early stages of the wished-for hypertrophic development.

R. Douglas Powell.

LUNGS, Induration of.—*See* Lungs, Inflammation of.

LUNGS, Infarction of.—*See* Lungs, Hæmorrhage into.

LUNGS, Infiltrations of.—Certain morbid formations in the lung assume the arrangement of an infiltration, the tissues, especially the interlobular cellular tissue, being permeated with the morbid material. In some instances it involves even the epithelial cells. The best examples of this arrangement are observed in connection with certain cases of the fibroid change; in infiltrated cancer; and in those forms of pulmonary disease where the lung-tissue is the seat of a deposit of substances introduced from without, being inhaled in various occupations, such as particles of carbonaceous matter and coal-dust, stone-grit, iron-filings, particles of cotton or wool, and other materials. Albuminoid disease, and some forms of pigmentary change also present a kind of infiltrated arrangement. These conditions need not be further considered here, as they are discussed in their several appropriate articles.

Frederick T. Roberts.

LUNGS, Inflammation of.—Synon.: Pneumonia; Fr. *Pneumonie*; Ger. *Lungenentzündung*.

Definition.—The term 'pneumonia' has been employed simply to designate inflammation of the lung-tissue. Inflammatory processes in the lungs, however, occur under such diverse circumstances, and are accompanied by such diverse clinical phenomena and histological changes, that 'pneumonia' used in this sense includes widely different diseases.

Varieties.—Pneumonias are divisible into the following varieties:—A. **Acute Pneumonia**; B. **Secondary Pneumonias**; C. **Broncho, Catarrhal, or Lobular Pneumonia**; and D. **Chronic or Interstitial Pneumonia**. In addition to these there are those intense and concentrated forms of pulmonary inflammation which lead to the formation of *abscess*.

There are certain other forms of lung-consolidation which have sometimes been described as pneumonic, but which are really, for the most part, non-inflammatory in their nature, and will, therefore, be only briefly alluded to in the present article. These are:—(1) that condition of collapse and hyperæmia, mainly due to weak inspiratory power, feeble circulation, and gravitation, which is so common in the more dependent portion of the lungs in many acute and chronic diseases (*see* Hypostasis). (2) Consolidations of the lung resulting from mechanical congestion and embolism, such as are met with in certain diseases of the heart, &c. *See* Lungs, Hyperæmia of.

The several varieties of pulmonary inflammation must now be considered separately in the order just indicated.

A. Acute Pneumonia.—Synon.: Fr. *Pneumonie aiguë*; Ger. *Croupöse Pneumonie*.—This is pneumonia *par excellence*. It is the disease to which some would be inclined to restrict the application of the term. It is often termed *croupous* pneumonia, from the supposed resemblance of the histological process to that of croup. It is also known as *lobar* pneumonia, inasmuch as a large area of the lung is usually involved in the inflammation.

Definition.—Pneumonia may be described generally as an acute disease, characterised clinically by sudden onset, severe febrile symptoms, cough, expectoration, and dyspnœa; by the physical signs of pulmonary consolidation; and by a rapid abatement of the general symptoms between the fourth and tenth days. Anatomically it is characterised by an acute inflammation of the lung-tissue, and by the accumulation of the inflammatory products within the alveoli, which products consist, in the main, of a fibrinous exudation and leucocytes.

Ætiology.—*Atmospheric influences.*—Conditions of weather and climate are probably the most important of all known agencies in the causation of pneumonia. The influence of cold and damp in increasing the liability to acute inflammatory diseases of the chest is well known. This influence is marked in pneumonia, although to a much less extent than in bronchitis. Pneumonia is more common in temperate climates than in those regions which are characterised by great heat or extreme cold. Climates and seasons which are liable to sudden changes of temperature, and winds from the north and north-east, appear to be especially favourable to this disease.

Age.—Acute pneumonia is met with between the ages of one and five years. Here, however, it is liable to be confounded with broncho-pneumonia and with collapse of the lung, so that the results of statistics are less reliable at this than in the subsequent periods of life. It may be stated notwithstanding, that acute pneumonia is less common during infancy than has been generally supposed, and that amongst the pneumonias which are so frequent during this period of life the broncho-catarrhal forms preponderate. After the age of five years the liability to pneumonia diminishes, but it again becomes exceedingly frequent between the ages of twenty and forty, during which period the liability to the disease reaches its maximum. It is also quite common in old age.

Sex.—In adults more males than females suffer. This is probably owing to the former

being more exposed to atmospheric influences. In early life this difference does not obtain.

Social position, &c.—Pneumonia is more common amongst the poor and badly fed, and amongst those whose occupation necessitates an irregular mode of life and great exposure, than amongst the upper classes of society.

Constitution, and health. — Those who are constitutionally weak, and those whose general health has been impaired by some temporary cause, are more prone to the disease than the strong and vigorous.

Previous diseases. — True pneumonia, as is well known, sometimes occurs in those who are the subjects of other disease. It is impossible to speak with certainty as to the relation which subsists between the pneumonia and the disease in the course of which it supervenes. In some cases it may be merely an accidental complication; whilst in others the previous disease may exercise more or less influence in the causation of the pneumonia. Most of the pulmonary consolidations, however, which occur in the course of other diseases do not belong to the category of true pneumonia, but are either local inflammations, caused by some abnormal state which the pre-existing disease has induced; or conditions of hyperæmia and collapse, in which an inflammatory process plays but little part.

Exciting causes.—In many cases of acute pneumonia evidence of the existence of any exciting cause is entirely wanting. Of discoverable causes, that which is most common is a sudden chill. or less frequently, more prolonged exposure to cold and damp. Excluding cold, no conditions can be mentioned which have any marked influence in determining the disease.

Anatomical Characters.—The changes occurring in the lungs in acute pneumonia are commonly described under the three following heads :—

1. *Stage of engorgement.*—This is the stage of inflammatory hyperæmia and œdema, and it is characterised microscopically by overfulness and slight tortuosity of the pulmonary capillaries, and by swelling of the alveolar epithelium. The lung is of a dark red colour; it is heavier and less crepitant than natural; it pits on pressure; and its cut surface yields a reddish, frothy, tenacious liquid.

2. *Red hepatisation.*—Here there is an exudation of liquor sanguinis and blood-corpuscles. The exuded liquids coagulate within the alveoli and terminal bronchioles, the coagulum enclosing numerous white and a few red blood-corpuscles. The alveolar epithelium is swollen and granular. It is stated by some German pathologists that the coagulum is in part produced by changes in the epithelium. The lung is now much heavier than in the preceding stage, and is increased in size, so as to be often marked by the ribs. It is quite solid; sinks in water; and cannot be artificially inflated. It is remarkably friable, breaking down with a soft granular fracture. The cut surface has a markedly granular appearance, seen especially when the tissue is torn, and due to the plugs of coagulated exudation matter which fill the alveoli. The colour is of a dark reddish-brown, often here and there passing into grey. This admixture with grey sometimes gives a marbled appearance. The pleura covering the solid lung always participates more or less in the inflammatory process. It is opaque, hyperæmic, and coated with lymph.

3. *Grey hepatisation.*—This stage is characterised by a continuance of the process of inflammatory cell-emigration, and by cell-proliferation. The white blood-corpuscles continue to escape from the vessels, and the alveolar epithelium multiplies. The alveoli thus become more completely filled with young cell-forms, so that the fibrinous exudation is no longer visible as an independent material. Many of these cells, especially those in the vicinity of the alveolar walls, are larger than leucocytes and nucleated. These are evidently the offspring of the alveolar epithelium. The fibrinous exudation now disintegrates, and the young cells rapidly undergo fatty metamorphosis. The alveolar walls themselves, with few exceptions, remain throughout the process unaltered; although very occasionally, when this stage is unusually advanced, they may be found here and there partially destroyed. Owing to these changes, the reddish-brown colour of the lung becomes altered to a greyish or yellowish white. The granular appearance is much less marked; the solid tissue is much softer and more pulpy in consistence; and a puriform liquid exudes from the cut surface of the organ. This stage, when advanced, has been termed 'suppuration' of the lung.

Although these three stages of the pneumonic process have been described as succeeding one another in orderly succession, it must be remembered that each stage does not occur simultaneously throughout the whole of the affected area of the lung. The changes advance unequally, so that whilst one portion of the lung is in the stage of red hepatisation, another may be in the grey stage—hence the mottled, marble appearance of the consolidation. The rapidity with which the several stages succeed one another is also subject to marked variations. In some cases the pneumonic consolidation very rapidly becomes grey, whilst in others the time occupied in the transition is much longer. These differences will be again alluded to when considering the clinical history of the disease.

Resolution.—The natural and almost invariable termination of the histological process is in *resolution*—the lung gradually returning to its normal condition. This is effected by the fatty and mucoid degeneration, and consequent liquefaction, of the inflammatory products which have accumulated within the alveoli. As the liquefaction proceeds, the circulation in the alveolar walls is gradually restored; the softened products are removed by absorption, and to a much less extent by expectoration; and the lung ultimately regains its normal characters. The other exceptional modes of termination in *gangrene*, *abscess*, and *chronic pneumonia* will be alluded to subsequently.

Site.—The local lesion in acute pneumonia is in the majority of cases limited to one lung. When double, one lung is usually involved before the other. The right lung is more commonly affected than the left. The part of the lung usually involved is the lower lobe (about 75 per cent.) The consolidation may extend upwards and implicate

the whole lung. Pneumonia of the upper lobes is more frequently double than basic disease. It is quite rare for the pneumonic process to commence in two different portions of the lung. When the consolidation is met with in both lungs, or commencing in the upper and middle lobes, the pneumonia is often either a secondary affection, and has supervened in one whose health has been previously injured, as by alcohol; and such distributions of the local lesion should always make the physician look carefully for evidence of some pre-existing disease.

Pathology.—Acute pneumonia is undoubtedly to be regarded as a general disease, of which the pulmonary inflammation is the prominent local lesion. The view that it is a strictly local affection of the lung, to which the pyrexia and other symptoms are secondary, is altogether untenable. The truth of this statement becomes obvious from a study of its natural history. The disease, as will be seen subsequently, runs a typical course. The pyrexia bears no definite relation to the lung-affection. It frequently precedes it by a considerable interval, and commonly disappears suddenly, and long before the resolution of the pulmonary consolidation.

Respecting the exact nature of the disease, however, we are at present unable to speak definitely. It is maintained by some observers that, like the specific fevers, it is due to a specific cause. Pneumonia, whilst differing from these fevers in not being contagious, resembles them in the typical character of its clinical phenomena, and to a less extent, of its local lesion. The changes in the lung occurring in pneumonia cannot be induced by artificial injury of the organ, and it must therefore be admitted that there is something special in the inflammatory process. Pneumonia appears to be most closely allied to tonsillitis and acute rheumatism, and like these diseases the circumstances under which it originates are certainly exceedingly diverse.

Symptoms.—The onset of acute pneumonia is in the majority of cases sudden, not being accompanied by any premonitory symptoms. Much less frequently certain premonitory symptoms precede the more severe phenomena which characterise the invasion of the disease. These symptoms include general malaise, headache, chilliness, pains in the back, and loss of appetite.

Invasion.—The invasion in adults is, in almost all cases, announced by a rigor. This rigor is more marked in pneumonia than in almost any other disease. The rigor is usually single, and is rarely repeated, either at the commencement or in the course of the illness. In very old subjects the rigor is very frequently absent, and in children its place is often taken by convulsions or vomiting. The rigors or other phenomena marking the invasion of the disease, together with the attendant pyrexia, are usually quickly followed by symptoms pointing to the lung-affection. These symptoms commonly supervene in the course of from twelve to twenty-four hours, although in exceptional cases not until after the lapse of two or three days. The earliest of them are pain in the side, dyspnœa, and cough. These more local symptoms, together with the pyrexia, acceleration of pulse, thirst, and prostration, gradually develop up to the second day of the disease, by which time (and sometimes before this) the pulmonary lesion is usually sufficiently far advanced to yield unequivocal physical signs. The general aspect and symptoms of the patient are now tolerably characteristic. The flushed and sometimes dusky face, anxious expression, hurried breathing, hot skin, rapid pulse, short frequent cough, and marked prostration, supervening quickly upon the well-marked initial rigor, indicate pretty clearly the nature of the disease.

Pain.—The pain in the side, which is increased by deep inspiration and by cough, usually corresponds in situation with that of the affected lung, although it is occasionally experienced in other parts. This symptom may occur coincidently with, although it more commonly succeeds, the rigor. In quite exceptional cases it precedes it, being the first symptom noticed. Respecting its cause—it is probably due to the implication of the pleura in the inflammatory process.

Respiratory phenomena.—Increased frequency of respiration, dyspnœa, and cough, are early and prominent symptoms. The respiration—usually regular—ranges from 30 to 50, and in children reaches even to 70, whilst the pulse may be only from 90 to 120. This perversion in the pulse-respiration ratio is important in diagnosis. The breathing is shallow; inspiration is abrupt; and when the pain in the side is severe, respiration is sometimes irregular. The accelerated respiration is accompanied by marked expansion of the *alæ nasi*, and by more or less dyspnœa. There is, however, no definite relation between the last-named symptom and the frequency of the respiratory act. Owing to the pain, and to the frequency and difficulty of breathing, speech is interfered with and often rendered exceedingly difficult. Cough is an almost constant symptom, except in the very old. It is short and hacking, rarely paroxysmal like that of bronchitis. It is usually in the early stages attended with severe pain in the side, so that the patient endeavours to repress it. The cough, except in children, and often in the old, is attended by expectoration. The sputa of pneumonia are very characteristic. They are viscid, glairy, and remarkably tenacious, so that they cling to the mouth of the patient, and adhere closely to the sides of the vessel containing them. In colour, they present various shades of red, brown, and yellow, owing to the admixture of blood. The appearance so well known as 'rusty,' is that most commonly met with. Sometimes they are much more diffluent, and of a dark purple colour, somewhat resembling prune-juice. The characteristic sputa are usually met with on the first or second day of the disease, but their appearance is often preceded by a frothy aërated expectoration like that of bronchitis. The amount expectorated is small, and sometimes the pneumonic is associated with more or less of the frothy catarrhal sputa throughout the whole of the disease. During the period of resolution the sputa become less viscid and more catarrhal in character, and they usually contain small particles of black pigment. The histological elements met with in the sputa are leucocytes, red blood-cells, and altered epithelium from the alveoli and air-pas-

sages; and towards the decline of the disease, fat-granules, pigment, and occasionally fibrinous masses, which are casts of the alveoli and terminal bronchioles.

Pulse.—The pulse in adults usually ranges from 90 to 120, and it may be even more frequent. It is commonly much more rapid in children, and less so in the old. In the early stage of the disease it is often full and strong, but it soon becomes smaller and easily compressible. It may be irregular, intermittent, or dichrotous. The smallness of the pulse is probably due partly to diminished cardiac power, and partly to the diminished amount of blood which is propelled from the left ventricle, owing to the overloading of the right cardiac cavities which results from the obstructed circulation in the lungs.

Pyrexia.—The pyrexia of pneumonia is continuous, with slight morning remissions and evening exacerbations. The temperature rises very suddenly with the invasion of the disease, to from 102° to 105° Fahr.; and this high temperature is maintained until the period of crisis. This sudden rise and maintenance of a high temperature is very characteristic. The amount of elevation varies in different cases. As a rule it does not exceed about 104° or 105° Fahr., but temperatures of 107° have been known to terminate favourably. In fatal cases it may reach 109° shortly before death. The maximum temperature is usually met with on the second or third day of the disease, but it occasionally occurs immediately before the crisis. The daily variations are usually as follows:—The temperature is lowest about 7 or 8 A.M. In the forenoon, or somewhat later, it commences to rise, and attains its maximum in the early evening. It then falls, but a slight exacerbation occasionally occurs again at midnight, after which it gradually falls. The difference between the highest and lowest temperatures is usually not more than 1° Fahr. The pyrexia runs, for the most part, a uniform course until the period of crisis, when the temperature falls rapidly, in the manner to be hereafter described.

Nervous system.—Headache, restlessness, and sleeplessness are almost always prominent symptoms. Slight delirium is also common, especially towards evening, when the pyrexia is at its maximum. Sometimes the delirium is more marked and violent. It constitutes a more prominent symptom in the old, and in the debilitated and intemperate. In drunkards it is constantly present, and here it often assumes the character of delirium tremens. Convulsions are common in children, especially at the period of invasion. They are rare in the adult. These nervous symptoms are sometimes so prominent as to mask the nature of the disease.

Digestive organs.—The symptoms of acute pneumonia referable to the digestive system are similar to those met with in other severe febrile diseases. There is loss of appetite and thirst. The tongue is more or less thickly coated with a white fur, and it tends in severe cases to become dry and brown. Herpes often appear about the lips, and sometimes on other parts of the face, about the third or fourth day of the disease. Vomiting, which is a common symptom of invasion in the child, is an occasional complication, as is also diarrhœa; constipation, however, is the rule.

Urine.—The quantity of urine is considerably diminished, and its specific gravity increased, so that abundant urates are deposited. The excretion of urea is greatly increased, and it may amount to as much as seventy-five grammes in the twenty-four hours. The uric acid is likewise augmented. The chloride of sodium is much diminished, and during the height of the disease it may entirely disappear. Slight temporary albuminuria is perhaps more common in pneumonia than in almost any other acute febrile affection. The amount is usually in direct proportion to the severity of the disease. Bile-pigment is occasionally met with.

Course and Terminations.—The symptoms which have been described continue with often increasing severity up to about the end of the first week of the disease, sometimes longer, when an improvement usually occurs. This improvement may take place quite suddenly, and the disease rapidly terminate in health—termination by *crisis*; or the recovery may be more gradual—termination by *lysis*. In other cases *death* occurs either before or after the crisis. The disease may also terminate in *gangrene* of the lung; in pulmonary *abscess*; or in *chronic pneumonia*. These several modes of termination must be considered separately.

Complete recovery.—This is the most common termination of acute pneumonia in young and healthy adults, and the improvement usually occurs quite suddenly—by *crisis*. The time at which this crisis takes place, as indicated by the sudden fall of temperature, varies from the third to the twelfth day. In the majority of cases it is on the fifth, sixth, or seventh day; it is occasionally as early as the third day; and sometimes it is prolonged into the middle of the second week. The old doctrine that the crisis always occurs on the odd days is untenable.

The supervention of the crisis is sometimes indicated by a change in the pulse, which becomes softer, and somewhat irregular in force and rhythm. The most marked phenomenon attending it is the abrupt fall of the bodily temperature. This fall may commence either during the morning remission or the afternoon exacerbation. It appears to be most common late in the afternoon. The temperature very often reaches the normal standard in from sixteen to twenty-four hours, usually within forty-eight hours; the morning remission and evening exacerbation occurring during the period of defervescence. The temperature not unfrequently falls to 1° or 2° Fahr. below normal, and may remain so for two or three days. Occasionally a marked increase in the pyrexia is observed immediately before the commencement of defervescence.

With the fall of temperature all the symptoms rapidly improve. The skin becomes moist and often perspires profusely. The amount of urine increases. The respiration falls in frequency; and, to a less extent, the pulse. The cough becomes looser, and the expectoration more copious; the sputa gradually losing their tenacity and rusty colour, and becoming more bronchitic in character. They are now usually

mingled with more or less black pigment. An improvement in the physical signs is sometimes observed at the same time; more commonly, however, this does not take place till one or two days later. The patient often falls into a deep sleep, and on waking, with the exception of great weakness, declares himself pretty well and begins to ask for food. In some cases, however, the amount of prostration following the crisis is so great that the return to health is more gradual, and a condition of collapse may ensue which may even terminate in death.

In the majority of cases acute pneumonia terminates abruptly in the manner above described. Sometimes, however, recovery is more protracted, and defervescence may not be complete till the end of the second week, the temperature falling more gradually—by *lysis*. The critical fall of temperature is occasionally interrupted by more or less marked exacerbations, due either to the implication of fresh portions of the lung, or to the supervention of one of the complications to be hereafter alluded to. In some cases, again, after the occurrence of the crisis, the temperature assumes a hectic type, and does not quite reach the normal standard for perhaps two or three weeks; the irregular fever being due probably to the contamination of the blood by the absorbed pneumonic products (Parkes). Lastly, a distinct relapse may occur after the completion of crisis; but the relapse is in most cases shorter and less severe than the primary attack.

Death.—When pneumonia terminates fatally, it usually does so towards the end of the first, or quite at the beginning of the second week. Death is commonly due partly to failure of cardiac power, and partly to apnœa. Apnœa is the least important element in the causation of dissolution. The danger from it increases with the extent of lung involved, and it is consequently usually greater in double than in unilateral disease. Failure of cardiac power is undoubtedly the most important means by which pneumonia destroys life (Juergensen). There are several conditions in the disease which tend to damage the contractile power of the heart. First and foremost of these is the pyrexia. The severe pyrexia of pneumonia, like that of other acute febrile diseases, produces more or less granular degeneration of the cardiac muscular fibres. It also necessitates increased frequency of the cardiac contractions, in order to supply the increased demand for oxygen, and to remove the excess of carbonic acid. Owing to this increased frequency, the length of diastole—the period during which the heart rests and is nourished—is shortened. The condition of the lung itself constitutes another important element tending to damage the contractile power of the heart, and especially of the right ventricle (Juergensen). The lung-consolidation not only presents more or less obstruction to the pulmonary circulation, and hence necessitates increased action on the part of the right ventricle; but owing to the diminished respiratory surface, this ventricle is obliged to do more work in order that the proper interchange of gases may be effected in the lungs.

Such being the modes by which pneumonia tends to destroy life, it will be readily understood that the earliest and most important signs of unfavourable augury are on the side of the circulation. The pulse becomes more frequent, small, irregular, and often dichrotous. The frequency of the respiration, the dyspnœa, and the cyanosis increase. The cough becomes feeble and ineffectual. Owing to the engorgement and failure of power of the right ventricle general pulmonary œdema usually supervenes, so that moist *râles* are audible at both bases. The extremities become cold, and there is often profuse perspiration. The mind wanders, and a condition of partial coma supervenes before the close. In some cases a rapid rise of temperature takes place before the fatal termination, whilst in others there may be a considerable fall in the thermometer.

Pneumonia may also terminate fatally from the state of collapse which follows the crisis. Lastly, in those exceptional cases in which the pneumonia tends to become more or less chronic, death may occur during the third or fourth week. Death may also result from the complications.

Gangrene.—This is quite rare. It is most common in chronic drunkards, and in those of debilitated constitution. Its occurrence appears to be due partly to blocking of vessels, and partly to the septic influence of altered inflammatory products. It is usually limited to a small area of the pneumonic lung; and is either diffuse, or becomes limited by a zone of inflamed tissue. It commonly supervenes late in the disease; and the most reliable signs of its occurrence are marked fœtor of the expectoration, and great prostration. Portions of lung-tissue are occasionally found in the sputa. It is almost invariably, but not necessarily, fatal.

Abscess.—This is somewhat more common than the preceding. *See* Lungs, Abscess of.

Chronic pneumonia.—Acute pneumonia in very exceptional cases becomes chronic, and leads to induration of the lung. *See* D. Chronic Pneumonia.

Physical Signs.—The earliest physical signs of acute pneumonia are usually discoverable within forty-eight hours of the invasion of the disease. They often appear within twelve or twenty-four hours; but occasionally, when the local lesion is deeply seated, nothing abnormal is to be detected until the third or fourth day. It will be well to describe them in the order in which they commonly make their appearance. The time occupied in their evolution will vary according to the rapidity with which the several stages of the pneumonic process succeed one another.

The earliest abnormal physical signs are due to the pain caused by the movement of the affected side; to the hyperæmia of the pulmonary capillaries; and to the commencing exudation into the air-vesicles. The respiratory movements of the side are more or less impaired. This is partly owing to pain, and partly to diminished elasticity of the lung-tissue. The breath-sounds are usually somewhat weak and harsh, but not distant; although, as stated by Stokes, they are occasionally in the earliest stage harsher and louder than natural. Per-

cussion during this stage is usually not markedly altered. The resonance, however, is sometimes quite appreciably tympanitic, but as the disease progresses the tone becomes impaired. The tympanitic quality of the resonance is caused by the diminished elasticity of the still air-containing lung. The vocal fremitus is increased. The most important sign, however, of the congestive stage is *fine crepitation*. This *râle* consists of a number of fine, dry, crackling sounds, following one another in rapid succession, which have been aptly compared by Dr. C. J. B. Williams to the sounds produced by rubbing the hair between the fingers close to the ear. It occurs during the later period of this stage, when the process of exudation from the pulmonary capillaries is commencing to take place. Its production is probably due to the partial agglutination of the walls of the air-vesicles and their forcible separation during the inspiratory act. The *râle* is almost exclusively limited to inspiration. It is intensified by deep inspiration and also by cough, and it is sometimes necessary to make the patient cough in order that it may be produced. A precisely similar *râle* is often heard with deep inspiration in portions of the lung which have been imperfectly expanded. Such imperfect expansion is common in the posterior parts of the lungs of patients who have been confined to bed from acute or chronic disease, and in whom, owing to muscular weakness, inspiration is incompletely performed. The *râle* produced under these circumstances is distinguished from pneumonic crepitation inasmuch as it completely disappears after a few deep inspirations, whereas the pneumonic *râle* when once established persists until the consolidation of the lung is tolerably complete.

The physical signs of the stage of hepatisation are due to the more or less complete consolidation of the lung. The fine crepitation which characterised the later periods of the preceding stage continues during the process of consolidation, but ceases as the filling of the air-vesicles becomes complete; although it may often still be heard at the confines of the more firmly consolidated lung. It occasionally happens, however, when the consolidation is very rapidly induced, that no crepitation is heard throughout the course of the disease until the period of resolution. When the lung has become consolidated, the expansive movement of the corresponding portion of the chest, which was before diminished, ceases. The intercostal spaces, although sometimes slightly more prominent than in the healthy side, are still depressed and not obliterated as in pleural effusion. When the amount of exudation is very considerable, slight enlargement of the side is necessarily produced. The situation of the cardiac impulse is not altered. The vocal fremitus is usually increased. To this general rule, however, there are exceptions, and it not unfrequently happens that it is unaltered, and it may even be completely absent. This diminution in the vocal fremitus is sometimes due to the blocking of the smaller bronchi with the inflammatory exudation, but more frequently it appears to result from an accumulation of mucus. In the latter case it may sometimes be restored by cough. Coincidently with the increase of vocal fremitus there is usually increased vocal resonance, and sometimes whispering pectoriloquy (Walshe and Wilson Fox). The percussion-sound now is much more deficient in tone, and it is often more or less amphoric. This amphoric quality is probably obtained from the columns of air in the larger bronchi and trachea. There is also a great increase in the sense of resistance, but neither the dulness nor the resistance are so marked as in pleural effusion. In basic disease percussion under the clavicle often yields a distinctly amphoric note, whilst the lower portions of the chest may be almost absolutely dull. The auscultatory sign of this stage is bronchial breathing. This is usually remarkably superficial, high-pitched, and metallic in quality (tubular breathing). Sometimes, however, it is less metallic and softer (diffused blowing—Walshe). These respiratory phenomena, like the vocal resonance and fremitus, may be absent over larger or smaller areas of the consolidated lung, owing to the obstruction of the bronchi by catarrhal secretion. The slight pleurisy which constantly accompanies the pneumonia is rarely susceptible of physical demonstration during this stage. This is probably owing to the immobility of the solid lung. During the period of resolution, as expansive power returns, friction-sounds are occasionally audible.

Resolution usually commences in those portions of the lung which were the last to become consolidated. The most important and the earliest of the signs of resolution is the return of crepitation. The crepitation, however, differs from that met with in the earlier stages of the disease. It is larger, coarser, and more liquid in character—*redux crepitation*; and its liquid character gradually increases until it may become distinctly bubbling. When resolution is very rapid, redux crepitation may be absent (Wilson Fox). The bronchial breathing now loses its metallic ringing quality; the percussion-dulness gradually disappears; and the respiration regains to a great extent its normal characters.

The commencement of resolution and of the improvement in the physical signs occasionally takes place, as already stated, coincidently with the establishment of crisis; but more commonly it is not observed until from twenty-four to forty-eight hours after the temperature has reached the normal standard. The time occupied in the completion of resolution varies. Sometimes all physical signs almost completely disappear in twenty-four hours. Usually, however, resolution is less rapid, and marked signs of consolidation remain for periods varying from two or three days to two weeks. A slight amount of dulness and some weakness of respiration often persist at the posterior and inferior portions of the lung for even still longer periods. This is especially the case if the pneumonia is complicated with pleurisy. When marked signs of consolidation exist after the third week, there always exists more or less probability that the pneumonic process may become chronic.

Varieties. — The three following varieties of pneumonia present clinical phenomena some-

what different from those which have been described.

a. Latent pneumonia.—Pneumonia has been termed *latent* when the characteristic symptoms of the disease are absent, or but little pronounced; or when they are masked by some other clinical phenomena. It is in the pneumonia of the aged that marked latency is so often observed. Here invasion may be unattended by rigor or other prominent symptoms. Cough, expectoration, pain, and dyspnœa may be completely wanting. If cough be present the sputa often do not present the rusty tinge, but are simply transparent or muco-purulent. Pyrexia, some increased frequency of breathing, great prostration, and more or less muttering delirium, are the principal symptoms. The fever, however, is usually much less than in adults. This latent course of pneumonia it is important to bear in mind, as it indicates the necessity of making a most careful physical examination of the chest in all severe acute illnesses of the aged. In the pneumonia of drunkards and of young children, also, the accompanying nervous phenomena may be so prominent as to mask the nature of the disease.

b. Asthenic (typhoid) pneumonia.—When pneumonia occurs in those who are debilitated by previous disease, by the abuse of alcohol, by age, by privation, or other causes, the phenomena of invasion are usually not pronounced, and symptoms of intense prostration occur early. In many respects the course of the disease closely resembles that which has been just described as so common in the aged. The initial rigor and pain in the side are often observed; but cough is slight; and the expectoration, instead of the rusty-brown tint, may present a dirty brown or prune-juice appearance. Various symptoms of an asthenic type soon become prominent; the most important of which are low delirium, alternating with stupor; tremors; and paralysis of the sphincters. The tongue is brown and dry; sordes form on the teeth; the pulse is exceedingly rapid and feeble; and there is often slight jaundice and albuminuria. Death usually supervenes some time during the second week of the disease. After death the lung is usually found to be less firmly consolidated and less granular than in sthenic forms of pneumonia. The stage of grey hepatisation in some cases is exceedingly advanced, constituting what has been termed 'suppuration' of the lung (Sturges).

c. Intermittent pneumonia.—An intermittent variety of pneumonia is sometimes met with in malarial districts, which appears to be one of the results of malarial infection. According to Grisolle it occurs in intermittent and remittent forms. The former is characterised mainly by the complete intermissions which occur in the pyrexia. The temperature falls suddenly at the end of twenty-four hours; profuse sweating occurs; and the physical signs of the pneumonia almost entirely disappear. A return of the pyrexia and physical signs takes place at the expiration of twenty-four or forty-eight hours, followed by another intermission, and this by a third or fourth, the disease presenting either a quotidian or a tertian type. Both lungs are liable to be involved. In the remittent form there is a much less complete disappearance of the physical signs during the remission.

Complications.—*Pleurisy.*—Pleurisy of slight intensity and unaccompanied by effusion is, as already stated, almost invariably met with in acute pneumonia over those portions of the lung which are consolidated. This is natural to the disease, and cannot be regarded as a complication. Pleurisy of greater intensity, and attended by effusion, occurs in from five to fifteen per cent. of the cases. Signs of effusion are not usually discoverable before the third or fourth day of the disease. The amount of liquid varies with the extent of the lung-consolidation. When this is considerable, involving nearly the whole lung, there is but little room for effusion. The supervention of pleurisy does not commonly materially modify the course of the disease. It may, however, protract the period of defervescence. Its influence in interfering with the disappearance of the physical signs has been already alluded to. When pleurisy occurs on the side opposite to the pneumonia it constitutes a more dangerous complication.

Bronchitis.—This is also a common complication, especially in the aged and in young children. Many cases, however, which have been described as acute pneumonia associated with bronchitis, have doubtless been cases of bronchopneumonia. The bronchitis almost invariably affects both lungs. Its supervention is attended by an increase in the cough and in the amount of expectoration. When it involves the smaller tubes generally, it constitutes a serious complication.

Pericarditis.—This is less frequent. It may result from the direct extension of the inflammatory process from the pleura, or it may be a part of the general disease. It is a grave complication, and greatly increases the mortality.

Jaundice.—A slight yellowish tinge of the conjunctiva, and even of the skin, is not unfrequent in pneumonia, and has no clinical significance. It is probably in most cases owing to the congestion of the liver which results from the impeded pulmonary circulation—the distended portal veins pressing upon the bile-ducts. Much more extensive jaundice is also occasionally met with, which appears usually to be due to duodenal catarrh, and is attended by gastric symptoms. In other cases, especially in asthenic forms of the disease, a non-obstructive jaundice sometimes occurs, resulting from changes in the red blood-corpuscles. This is commonly associated with nervous symptoms, such as stupor, delirium, and a tendency to collapse, which are of grave prognostic import.

Parotitis.—This is a very rare and exceedingly serious complication. According to Grisolle, it is usually unilateral; the inflammatory process is very acute; and commonly leads to suppuration or gangrene.

Diagnosis.—The diagnosis of acute pneumonia, although usually easy, is sometimes attended with difficulty. It cannot be made with absolute certainty before the appearance of the physical signs of pulmonary consolidation, although some of the phenomena of invasion are so characteristic that the nature of the disease

is often tolerably evident before abnormal physical signs are discoverable. The phenomena which are of the most diagnostic value at this early stage of the disease are the pyrexia, the altered pulse-respiration ratio, the pain in the side, and the cough. The sudden and rapid rise of the bodily temperature, which usually reaches its maximum in forty-eight hours, is very characteristic; such a rapid attainment and maintenance of a high temperature being perhaps more common in pneumonia than in any other disease (Wilson Fox). Of the other symptoms, the increased frequency of respiration, and especially the alteration in the pulse-respiration ratio, are of the most valuable diagnostic import (Walshe). When physical signs of pulmonary consolidation are discoverable, which they usually are within forty-eight hours, the diagnosis becomes certain.

Difficulties in diagnosis may arise in those cases in which the local process in its earlier stages is deeply seated. Here, characteristic physical signs may be wanting for four or five days, during which time some doubt may exist as to the nature of the disease. Then, again, in those latent forms of pneumonia which have been already described the disease may be easily overlooked, unless a careful examination be made of the chest.

The diagnosis of pneumonia from other diseases of the lungs is rarely difficult. The disease with which it is most liable to be confounded is pleurisy. In pleurisy, however, there is not, as a rule, such a sudden and rapid attainment of a high temperature as in acute pneumonia; and when effusion has taken place, the physical signs are in most cases sufficiently distinctive. In pleural effusion the bulging of the side; the obliteration of the intercostal spaces; the displacement of the heart; the absolute dulness and sense of resistance on percussion; the weak and distant character of the respiration; and the diminished vocal fremitus and resonance, contrast with the signs of pulmonary consolidation.

Another disease with which pneumonia may be confounded is that somewhat rare form of very acute phthisis, in which a large area of the lung becomes rapidly consolidated—the consolidation being often in the main indistinguishable histologically from that met with in acute pneumonia. Here, however, although the whole lung may be involved, the disease usually commences in the upper lobes, so that abnormal physical signs are more marked at the apex. The onset of the disease also is commonly much less sudden, and its course is more protracted. Then, again, the rapid consolidation of the lower portions of the lungs which sometimes supervenes in more chronic forms of phthisis, might be mistaken for the consolidation of acute pneumonia; but the history of the case, a careful examination of the upper lobes of the lungs, the irregular course of the pyrexia, and the protracted duration of the disease, will easily serve to distinguish them. It may be stated generally that, in all acute consolidations of the lung, a protracted course of the pyrexia, and the occurrence of marked exacerbations and of remissions of the fever at irregular intervals, afford grounds for the supposition that the consolidation is phthisical.

The diagnosis of acute pneumonia from broncho-pneumonia and collapse of the lung, will be considered when treating of broncho-pneumonia. *See* Broncho-Pneumonia.

Prognosis.—The mortality from acute pneumonia varies at different periods, the disease being more fatal in some years than in others. This is probably partly owing to variations in what is called 'epidemic influence.'

Of all the circumstances which influence the prognosis of pneumonia, that which is perhaps the most important is the state of the general health. In weakly subjects, and in those whose constitutions have been damaged by previous disease, by privation, or by their mode of life, acute pneumonia is exceedingly dangerous. The prognosis is, however, especially grave in those injured by the long-continued abuse of alcohol, the mortality being, according to Huss, from 20 to 25 per cent.

In healthy children the mortality from pneumonia is comparatively small. The fatality formerly ascribed to the disease at this period of life was probably owing in great measure to the inclusion of cases of collapse and broncho-pneumonia in the statistics; the latter disease being exceedingly fatal. Healthy young adults rarely die; after the age of thirty the mortality increases considerably; and in the old pneumonia is an exceedingly fatal disease.

Pneumonia is more fatal in females than males, the mortality being in the proportion of three to two. Pregnancy renders the disease more dangerous.

The danger of pneumonia increases somewhat with the extent of lung implicated. It is, however, the implication of both lungs which renders the prognosis especially grave. With regard to the situation of the consolidation it may, perhaps, be stated generally that pneumonias commencing in the upper lobes are rather more serious than basic disease. The gradual extension of the consolidation late in the disease, and the spreading of the inflammatory process from one centre to another, constitute elements of gravity. When resolution is much protracted, the fact that the disease in very exceptional cases terminates in an indurative consolidation of the lung is not to be forgotten.

The mortality of pneumonia is greatly increased by the existence of complications. The prognostic importance of these has already been considered.

Of individual symptoms the pulse is of chief importance. A pulse which in the adult is persistently over 120, and in the child over 140, is of grave significance. Marked irregularity in force and rhythm is also unfavourable, especially in the young. Dichrotism may occur temporarily in quite favourable cases, but if it persists it indicates danger. The variations in respiration are of less import. An extreme quickness of breathing, marked dyspnœa, and cyanosis are not uncommon in cases which terminate in recovery; at the same time such symptoms must have more or less unfavourable significance. Sputa of a dark prune-juice colour are of somewhat evil augury; as is also an

abundant liquid puriform expectoration. The indications from the pyrexia are of less prognostic value in pneumonia than in most other acute diseases. A temperature of 105° or 106° Fahr. does not in itself indicate danger. Greater elevation is grave. In many fatal cases the temperature never attains 102°. The significance of a protracted defervescence has already been alluded to. On the side of the nervous system, it is to be remembered that slight delirium is not uncommon; but when it is marked, and especially when it occurs late in the disease, it is most grave. It is of greater significance in adults than in children. Tremors and a tendency to coma are also unfavourable. A dry, brown tongue is unfavourable, especially when associated with only a moderate degree of pyrexia. Gastric catarrh and diarrhœa add to the danger. A slight amount of jaundice is not of bad import. The existence of albuminuria, or the appearance of albumen in the urine early in the disease, is unfavourable.

Treatment.—In considering the treatment of acute pneumonia, it is of the utmost importance to bear in mind the true nature of the disease. All rational and successful therapeutics must be based upon the recognition of the fact, that it is a general, and not a local, affection which we wish to influence. The 'heroic' methods of treatment by venesection, tartar emetic, &c., so much in vogue in the past, had for their object the controlling or cutting short of a local affection of the lung; hence the unfavourable results which attended them. As these methods have been abandoned, and there has existed a more correct appreciation of the pathology of the disease, the mortality attending it has diminished.

When discussing the pathology of pneumonia, reasons were adduced for the belief that it owes its origin to a specific cause. Whether this be so or no, the disease is so closely allied to the specific fevers, that in attempting to influence its course by treatment, we must be guided by the same general principles. As in these fevers, our object must be to endeavour to conduct the pneumonia to a favourable termination. We cannot arrest its progress, but we can often do very much both to maintain the strength of the patient, and to modify those elements in the disease which tend to destroy life.

The modes by which pneumonia tends to destroy life have been already considered. Failure of cardiac power is the great source of danger. The causes of this failure it is important to bear in mind when treating the disease, and the reader is referred to what has been already stated respecting it. The natural course of the disease is also to be remembered. In the strong and robust pneumonia usually terminates in health. It is in those who are debilitated by age, privation, mode of life, the abuse of alcohol, or pre-existing disease, that such great mortality attends it. It is a question of the intensity of the disease on the one hand, and of the resisting power of the individual on the other. Such considerations as these not only indicate the importance of doing all that is possible to husband and support the strength of the patient, but also of not interfering too actively with the disease, unless circumstances arise which, if uninfluenced by treatment, would tend to rapidly prove fatal.

Such being the general principles which should guide the practitioner in the treatment of acute pneumonia, the manner in which they are to be best carried out may now be indicated.

The patient should be kept in bed. The room should be large and airy; and the temperature about 60° to 62° Fahr. It should be well-ventilated: a plentiful supply of fresh air is most important, and although due care should be exercised in the ventilation, there is not the same necessity to keep the patient scrupulously protected from draughts, as in the treatment of acute bronchitis.

The diet should be carefully regulated, nutritious, and easily digestible, consisting of milk, milk with the white of egg, beef-tea, meat essence, and such-like articles, given in varying quantities and at varying intervals, according to the condition of the patient. With the object of promoting the appetite, it is well to keep the mouth cleansed with glycerine and lemon-juice. Small quantities of wine, as hock, dry sherry, champagne, or burgundy, given occasionally with food, are often useful as stimulants to the appetite and digestive process. Some acid and bitter, as hydrochloric acid and orange-peel, may also be prescribed for the same purpose. If in the early stage of the disease there is great constipation, loaded tongue, nausea, or other gastric symptoms, the administration of a small dose of calomel, or of blue pill and colocynth, is often followed by marked improvement, both in the power to take food, and in the general condition of the patient. The exhibition of purgatives, however, requires great care, as they occasionally set up a catarrhal condition of the intestine, and consequent diarrhœa, which may prove more or less persistent. It is important, therefore, except in such cases as those above indicated, to procure all necessary evacuation of the bowels either by a small dose of castor oil, or of colocynth and hyoscyamus, or by simple enemata.

Everything should be done to husband the strength of the patient, and the services of an efficient nurse will often do very much towards the attainment of this object. Perfect rest must be enjoined, and all unnecessary speaking be forbidden. There are two circumstances which often tend greatly to interfere with rest—the pain in the side, and the cough. The former of these may usually be relieved by the application of large hot linseed poultices, or of hot fomentations to the side. These must be frequently changed, and great care should be exercised in their renewal not to disturb or inconvenience the patient. If these means do not succeed, from one-eighth to one-sixth grain of acetate of morphia may be administered hypodermically; or a small blister or three or four leeches may be applied to the seat of the pain, and the hot applications then renewed. Cough is not usually a troublesome symptom, and unless it greatly disturbs the patient, it is better not to interfere with it. If necessary, a linctus, containing from two to four minims of liquor morphiæ hydrochloratis and a similar quantity of vinum ipecacuanhæ, given occasionally, is

often beneficial. By means of the treatment above indicated, and by keeping the room quiet and darkened, the patient will often procure a sufficient amount of sleep. This can very frequently be promoted by carefully sponging the whole surface of the body, a portion at a time, with tepid water, the last thing at night. Should it be necessary, some narcotic must also be administered, but with great caution, so as not to interfere with freedom of expectoration; and it should only be had recourse to when other means have failed, and in the absence of contra-indications. Hyoscyamus and bromide of potassium may be safely used for this purpose; and should these fail, opium may also be given. This should be prescribed in a sufficiently large dose to ensure sleep, and is perhaps best administered hypodermically, as acetate of morphia. Chloral is usually contraindicated, on account of its depressing effect upon the circulation.

A very large number of cases of pneumonia terminate in health without the necessity of any further interference on the part of the physician than has been described. Frequently, on the other hand, circumstances arise indicative of danger, which require to be met by more active treatment. The chief source of danger, as already stated, is failure of cardiac power, and consequently all symptoms of such failure must be carefully watched for. Apnœa is less important, except in those cases where both lungs are extensively involved.

Any sign of cardiac failure will in the first place suggest the advisability of administering alcohol. The exhibition of small quantities of wine with food has been already recommended as sometimes useful in stimulating the appetite and assisting digestion, in cases where there are no symptoms of asthenia; but when such symptoms arise, alcohol must be employed in larger quantities. It may be stated generally that a pulse of over 120 or 130 calls for the employment of stimulants. Brandy appears in most cases to answer best. The amount administered must depend upon its effects; and although in most cases from four to eight ounces in the twenty-four hours will be sufficient, if the asthenia persist it must be given in very much larger quantities. Bark and camphor have also been employed as stimulants, and in some cases they are useful in addition to the alcohol.

In the treatment of failure of cardiac power, however, it is important to attempt to modify, as far as possible, those conditions upon which such failure principally depends. The most important of these conditions is the pyrexia (Juergensen). Various remedies have been employed with the object of diminishing pyrexia. Of these aconite, tartar emetic, and veratrum, although they all have more or less effect in relieving both the frequency of the pulse and the temperature, tend to weaken the heart, and are consequently contraindicated in pneumonia. Digitalis is perhaps less objectionable, but its liability, in the large doses in which it must be administered, to depress the circulation, renders its exhibition somewhat dangerous.

The two remedies which appear to be of most value in reducing the pyrexia of pneumonia are quinine, and the external application of cold. Quinine has been used more largely in Germany than in this country. It must be given in large doses—thirty grains or more. It is usually best to administer one dose early in the evening, and not to repeat this until after an interval of twenty-four hours; and it is often well at the same time to give a full dose of alcohol (brandy, an ounce to an ounce and a half). Quinine thus given undoubtedly in many, although not in all, cases produces a marked reduction in the temperature, and it is desirable to employ it when such a reduction is indicated.

A much more efficient agent in diminishing the pyrexia than quinine is the external application of cold. This mode of treatment also has been much more largely employed abroad than in this country, and here it is only in quite exceptional cases, where the temperature ranges very high (106° or 107° Fahr.) that its employment would be considered justifiable. The following is the method of procedure recommended by Professor Juergensen:—When the temperature reaches 104° Fahr. the patient should be placed in a bath at a temperature of 60° Fahr., and be kept there from seven to twenty-five minutes—according to the effect on the temperature. The pulse must be carefully watched, and stimulants be administered both before, during, and after the bath. If necessary the temperature of the water must be gradually reduced to 42° Fahr. The cooling process usually continues for about a quarter of an hour after removal from the bath. The bath must be repeated when the temperature again rises to 104° Fahr. Juergensen recommends this treatment before the supervention of symptoms of cardiac failure, with the object of diminishing the injury to the heart caused by the pyrexia. When there is marked asthenia, and the heart's action is already much enfeebled, such treatment requires to be employed with great caution, owing to the temporary depression caused by the cold, and the increased work at first thrown on the heart from the contraction of the peripheral blood-vessels. Under these circumstances the propriety of employing it is probably doubtful.

There are other methods by which cold may be applied externally with the object of reducing temperature, namely, by packing the patient in a wet sheet; by the application of ice-bags to the spine; and by sponging the surface of the body with cold water. These, however, are less effectual than the bath, and they often cause more distress to the patient. The effect of such treatment is not only to reduce the bodily temperature, but also the frequency of the pulse and respirations, and it often induces quiet sleep.

Although failure of cardiac power is the chief source of danger in pneumonia, dyspnœa is occasionally a most grave symptom, especially in those cases in which both lungs become involved. This dyspnœa is due partly to the lung-consolidation, and partly to the pyrexia; hence it will be only partially relieved by anything which reduces the temperature. It has long been known that the dyspnœa of pneumonia is diminished temporarily by venesection, and at the present day this is probably the only symptom for the relief of which the practice of bleeding would be considered at all justifiable. In

considering the advisability of removing blood in those cases in which dyspnœa constitutes an urgent symptom, it must, however, be borne in mind not only that the relief is merely temporary, but that the loss of blood must tend more or less to weaken the patient, and hence to favour that condition of asthenia which is of all things the most to be feared. Bleeding is certainly only to be thought of when the dyspnœa threatens life, and when at the same time the strength, as indicated by the pulse, is good; and it should not exceed the removal of eight or ten ounces of blood. Such cases are certainly not common; and when they do occur, it is a question whether it would not be safer practice to endeavour to relieve the dyspnœa by reducing the temperature (either by the cautious application of cold or by quinine), than to have recourse to the lancet.

Of the complications delirium sometimes calls for treatment. Active delirium is not common in pneumonia, except in those who have been intemperate. When marked it is always indicative of danger. In its management the practitioner must be guided by the general condition of the patient. It is usually accompanied by asthenia, and hence calls for the exhibition of stimulants. The influence of an experienced nurse is most important. If the pyrexia is considerable, the advisability of wet packing or of the cold bath should be considered. In many cases simply sponging the surface of the body with cold water produces a soothing effect. The application of ice to the head for a short time may also be tried. If these means fail in quieting the patient, and the delirium is very violent and prevents sleep, it may in some cases be advisable to administer an opiate. This should only be done, however, as a last resource, and when there is marked asthenia it is quite unadvisable. The opiate should be given in one full dose sufficient to procure sleep. Morphia administered hypodermically, or given with ammonia or brandy by the mouth, is perhaps the best form of exhibiting it.

Of the management of other complications occurring in the course of pneumonia there is nothing special to be remarked; they must be treated on general principles. The existence of bronchial catarrh often requires small doses of ipecacuanha, ammonia, and salines. Diarrhœa and gastric symptoms are to be met by careful dieting, chalk, bismuth, and, if necessary, other astringent remedies. In pneumonia, as in other acute diseases, the administration of an opiate enema is an efficient and safe means of checking diarrhœa. Pericarditis rarely admits of any special interference.

Convalescence.—During the period which immediately succeeds the crisis, the utmost care is required to support the patient, and to prevent any serious amount of prostration, which at this time sometimes supervenes. Stimulants are usually required for some days after the temperature has attained the normal standard. Convalescence in most cases is quickly established. Solid diet is soon desired, and may be safely given. Tonics —such as quinine, iron, and cod-liver oil—and change of air are useful in assisting the restoration to health.

B. **Secondary Pneumonia.**—DEFINITION.—Secondary pneumonia is a local affection, not a general disease. It is an inflammation of the lung occurring in those who are the subjects of some other disease; the pneumonic process standing in more or less causal relation to the disease in the course of which it supervenes.

Intercurrent Pneumonia.—Before proceeding to consider secondary pneumonia as thus defined, it is to be remarked that the general disease—acute pneumonia—occasionally occurs in the course of other diseases as an *accidental* complication, its occurrence not being influenced by the pre-existing condition. Such pneumonias may be termed *intercurrent*, and they are to be distinguished from the local secondary affections. They often closely resemble, in their clinical features, the acute disease as it has been already described; although in some cases they are more or less modified by the disease in the course of which they occur.

Hypostatic Pneumonia.—There is also a class of consolidations of the lung very common in those who are the subjects of other diseases, which are often described as secondary pneumonias, but which are really for the most part non-inflammatory in their nature; and will, therefore, be very briefly alluded to in the present article. These are those consolidations so often met with at the bases and more dependent portions of the lungs, in the course of both chronic and acute diseases, and also in the aged and cachectic. They have been termed *hypostatic pneumonias*, and consist, in the main, of collapse, hyperæmia, and œdema of the lung-tissue, resulting from weak inspiratory power, feeble circulation, and gravitation. The consolidation thus mechanically induced is increased by more or less exudation of liquor sanguinis and blood-corpuscles into the alveoli; which exudation is due to the damage to the walls of the capillaries caused by the blood-stasis (Cohnheim). There is also some swelling and proliferation of the alveolar epithelium. The frequent occurrence of this epithelial activity in collapsed and œdematous lung-tissue is discussed at greater length under the head of broncho-pneumonia.

ÆTIOLOGY.—Secondary pneumonias, as already stated, bear a causal relation to the disease in the course of which they supervene. They would seem to owe their origin almost exclusively to some abnormal condition which the pre-existing disease has induced. They occur in the course of many diseases, and sometimes appear to constitute the acute affection which determines dissolution. There is one disease in which such pneumonias are especially frequent — namely, Bright's disease. Pneumonia occurring in the course of Bright's disease, however, sometimes closely resembles the acute primary affection, and the Bright's disease is probably merely one of the elements concerned in its causation; but more frequently it is simply the local affection about to be described.

ANATOMICAL CHARACTERS.—The changes occurring in the lung in secondary pneumonia are, for the most part, precisely similar to those of the acute primary disease. In many cases, however, the consolidation is less dense; and

epithelial activity sometimes constitutes a more prominent feature in its production. The pleura is usually implicated, but not so invariably so as in primary pneumonia. When associated with Bright's disease, the consolidation often passes rapidly into the stage of grey hepatisation. With regard to the situation of the consolidation, it is more frequently situated in the upper and middle lobes, and is more often double, than is that of the primary disease.

Symptoms. — The clinical phenomena of secondary pneumonia differ from those of the acute primary disease, the symptoms so characteristic of the latter being almost entirely wanting. The symptoms which do exist are often but little pronounced, and the disease may even run an almost latent course. This latency of symptoms is often partly due to their being masked and modified by those of the disease to which the pneumonia is secondary.

The onset of the pneumonic process is usually unattended by rigors or other marked phenomena. Cough, expectoration, pain, and dyspnœa are often slight, and they may even escape observation. If cough be present, the sputa may be free from blood, and simply watery or mucopurulent. The pyrexia is moderate, the temperature often not being more than 100° Fahr. Not unfrequently slightly increased frequency of the respiration, with occasional cough, and symptoms of increased illness, are all that exist to indicate that pneumonia has supervened.

Diagnosis.—Owing to the frequent latency of the symptoms of secondary pneumonia, the diagnosis often rests, for the most part, upon the existence of physical signs of pulmonary consolidation. When the consolidation occupies the posterior and inferior portions of the lung, it may be impossible to distinguish it from simple hypostasis. *See* Hypostasis.

Prognosis.—The supervention of pneumonia in the course of a chronic disease usually, but by no means invariably, indicates that the disease will shortly terminate in death. The pulmonary inflammation appears to determine dissolution. Pneumonia occurring in acute diseases materially increases the gravity of the prognosis.

Treatment.—The treatment of secondary pneumonia usually resolves itself into that of the disease in the course of which it occurs. Warm applications to the chest, small doses of ammonia, and alcoholic stimulants may sometimes favourably influence the pneumonic process.

C. Broncho-Pneumonia.—Synon.: Catarrhal inflammation of the lungs; Lobular pneumonia; Fr. *Pneumonie lobulaire*; *Broncho-pneumonie*; Ger. *Bronchopneumonie*.

Definition.—Broncho-, catarrhal, or lobular pneumonia is inflammation of the lung-tissue associated with, and usually secondary to, inflammation of the bronchial mucous membrane. In the earlier stage the pulmonary inflammation is commonly limited to scattered groups of air-vesicles, hence the term *lobular* which is applied to this form of pneumonia. As the process advances, the inflammatory nodules may gradually coalesce so as to produce larger tracts of consolidation. The inflammatory products which fill the alveoli consist principally of cells, derived from the epithelium of the alveoli, and from the bronchial mucous membrane; exudation and emigration play a much less prominent part in the process than they do in acute pneumonia. Owing to this preponderance of epithelial products, and to the association of the pulmonary with the bronchial inflammation, the process is also known as *catarrhal* pneumonia.

Ætiology.—Broncho-pneumonia, as already stated, is invariably associated with bronchial catarrh. In some cases it would appear that the injury which produces the bronchial inflammation produces at the same time inflammation of the alveolar walls, but much more frequently the bronchitis precedes the pneumonia, and gives rise to it in a manner to be hereafter described. Whatever causes inflammation of the bronchial mucous membrane may thus be a cause of broncho-pneumonia.

Bronchitis is frequently followed by broncho-pneumonia, especially in childhood and in old age. All those conditions which favour the occurrence of bronchitis must therefore be enumerated amongst the causes of this form of pneumonia. Of these conditions it will be sufficient to mention here the marked influence of cold and damp, and, to a less extent, of heart-disease and emphysema; also the inhalation of irritating gases, and of an atmosphere containing irritating particles of solid matter.

It is the bronchitis associated with certain infectious diseases which is most liable to be followed by broncho-pneumonia. This is especially the case with that accompanying measles and whooping-cough. In both these diseases this form of lung-complication is exceedingly frequent. It also sometimes occurs in connexion with the bronchial catarrh of influenza and diphtheria.

All conditions which tend to impair the general health favour the occurrence of broncho-pneumonia. The weakly and debilitated suffer most. Bad air and insufficient food are most important predisposing causes. A state of malnutrition not only renders the bronchial mucous membrane abnormally liable to become inflamed, but also diminishes the power of the respiratory muscles, and thus aids in the production of pulmonary collapse, a condition which, as will be seen presently, is especially favourable to the pneumonic process. Owing to the general debility and weakness of the thoracic parietes in rickets, bronchitis in the subjects of this disease is exceedingly liable to be followed by broncho-pneumonia.

Broncho-pneumonia is most common during the first four years of life—the period when bronchial catarrh, measles, and whooping-cough are so frequent. It is also common in old age. In young adults it is comparatively rare. Sex has no influence.

Anatomical Characters.—The appearances presented by the lungs after death vary. The bronchi always exhibit signs of more or less bronchial catarrh. This may involve the whole of the bronchial mucous membrane, but it is usually most marked in the smaller tubes. These are found containing a thick, tenacious, and often

puriform secretion, which is occasionally here and there drier or inspissated. The mucous membrane of these tubes is more or less softened, swollen, red, and thickened, and often presents irregular superficial erosions. Owing to this inflammatory swelling the tubes stand out prominently on section of the lung. Cylindrical dilatations of the tubes are also frequently met with.

The lung-tissue itself exhibits, associated in various degrees, collapse, congestion, œdema, emphysema, and pneumonic consolidation. The bluish, non-crepitant, depressed portions of collapse, which become darker and more friable with age, are usually most abundant in the lower lobes and margins of the lungs. The collapse sometimes involves the whole of one lobe, but more commonly it is limited to much smaller areas of the lung. When scattered and limited in its distribution, there is usually more or less emphysema of the intervening portions of the lung; when very extensive in the lower lobes, the emphysema is most marked in the upper.

Those portions of the lung in which the pneumonic process has supervened most commonly appear as scattered nodules of consolidation, varying in size from a small pea to a hazel nut. These are ill-defined and pass insensibly into the surrounding tissue, which is variously altered by congestion, collapse, and emphysema. They are of a reddish-grey colour, slightly elevated, smooth, or very faintly granular, and soft and friable in consistence. As they increase in size they may become confluent, and thus are produced larger tracts of consolidation. In a more advanced stage, the nodular and more diffuse consolidation becomes paler, firmer, and drier, and somewhat resembles in colour the greyish-yellow hepatisation of acute pneumonia. The cut ends of dilated bronchi, filled with pus, are occasionally seen in the centres of the pneumonic nodules.

Microscopical characters. — When examined microscopically this consolidation is seen to consist of an accumulation within the alveoli of a gelatinous mucoid-looking substance, small cells resembling leucocytes, and epithelial elements. In many cases much of this accumulation is precisely similar to that contained in the smaller bronchi; and it is evidently the inflammatory and richly cellular bronchial secretion which has been inhaled. At the same time it is in the highest degree probable that it is partly the result of exudation and emigration from the pulmonary capillaries; such exudation and emigration, however, do not play nearly such a prominent part in the process as they do in acute pneumonia, and a fibrinous coagulum is rarely met with. Associated with this material are large epithelial elements, probably the offspring of the alveolar epithelium. These vary considerably in number. In some portions of the consolidation they may be very few, whilst in others they may constitute the predominant change. These differences probably depend upon how far the inhalation of the bronchial secretion constitutes a part of the process. The epithelium covering the alveolar walls is more or less swollen and granular, and is often loosened from its attachment.

Many of the nodules of consolidation met with in the lungs after death from broncho-pneumonia, differ somewhat from those which have been described. They are smaller and softer, of a more yellow colour, less prominent, and less granular; and on scraping, a puriform liquid is obtained from them. These consist almost exclusively of puriform secretion inhaled from the bronchi; and there is an almost complete absence of epithelial elements, and of other evidence of alveolar inflammation. Some of these nodules are merely the cut ends of dilated bronchi filled with pus.

The pleura is usually more or less injected, and a little lymph with small ecchymoses are commonly met with. These appearances are most marked in the vicinity of the sub-pleural pneumonic nodules.

The subsequent changes which take place in the lungs vary. When the disease does not end in death, resolution is the most common termination. The contents of the alveoli undergo fatty degeneration, and are removed by expectoration and absorption, the lung gradually regaining its normal characters. This process, however, is less readily effected than in the consolidation of acute pneumonia; and it often occupies such a lengthened period that some thickening of the bronchial and alveolar walls, and dilatation of the smaller bronchi remain. In still more chronic cases the fibroid thickening is much more marked, and considerable irregularly-distributed pigmented induration and bronchial dilatation may be produced (*see* Chronic Pneumonia). In these chronic forms the contents of the alveoli sometimes caseate, and the caseous products and thickened alveoli may, in exceptional cases, disintegrate, and thus lead to the destruction of the lung. Such a result comes under the category of phthisis, and will therefore not be described in the present article.

Pathology.—The inflammation of the bronchial mucous membrane, which is invariably associated with broncho-pneumonia, in the great majority of cases precedes and is the principal cause of the pneumonic process. In exceptional cases it would appear probable that the same injury which produces the bronchial inflammation produces at the same time the inflammation of the air-vesicles. Inflammation of the bronchial mucous membrane may give rise to broncho-pneumonia in two ways:—(1) By causing, in the first place, collapse of the lung-tissue; and (2) by the direct extension of the inflammation from the bronchi to the air-vesicles. The pneumonic process being the result of the bronchitis almost invariably involves simultaneously both lungs.

1. *Broncho-pneumonia consecutive to collapse.* Collapse of the lung-tissue greatly favours the occurrence of broncho-pneumonia, and usually the pneumonic process is principally confined to those portions of the lung in which collapse has taken place. This is particularly the case in young children. Although it would be beyond the scope of the present article to discuss at length the relation which subsists between bronchial catarrh and pulmonary collapse, the mode of production of the latter may be briefly indicated. There are two circumstances principally concerned in the production of the collapse

which is consecutive to bronchitis—the narrowing of the bronchial tubes, and the weakness of the inspiratory power. The mucous membrane of the bronchi becomes considerably swollen as the result of the inflammatory process, often being thrown into folds; and its surface is covered with thick tenacious mucus. These conditions may cause so much narrowing of the smaller tubes as to render the entrance of air exceedingly difficult, and they may even completely prevent it. In addition to the bronchial narrowing the power of inflating the lungs is usually diminished. This is due partly to the general debility which so often exists prior to the bronchitis, and partly to the damage to the respiratory muscles caused by the febrile process. The superficial character of the respiration due to the fever also aids in the production of the collapse, as does also any weakness of the osseous structures of the thorax, such as exists in rickets. The collapse thus induced is especially frequent in the posterior and inferior portions of the lungs—those portions in which normally the inflation of the lung is the least complete. Commencing here the process may gradually extend upwards till large areas of both lungs become involved. In other cases, owing to a more irregular distribution of the bronchial obstruction, the collapse is limited to small isolated portions of the lung. These portions vary in size from a hemp-seed to a walnut. They are commonly more or less wedge-shaped, with their apices towards the bronchus leading to the group of collapsed lobules; and the lung-tissue around them usually presents various degrees of congestion and emphysema.

The tendency of the pneumonic process to occur in the collapsed portions of the lung is due partly to the hyperæmia which is induced by the collapse, and partly to the irritation of inhaled bronchial secretion. Collapse of the lung-tissue invariably induces more or less congestion. This is owing to the absence of the expansion and contraction of the air-vesicles, which normally aid the pulmonary circulation, and also to the impediment to the blood-flow resulting from imperfect aëration. This congestion is quickly followed by œdema, and the bluish-purple collapsed portions of the lung become deeper in colour, less resistant, and more friable in consistence. In lung-tissue thus altered an inflammatory process, characterised partly by exudation and partly by epithelial activity, is prone to supervene.

Another circumstance which often appears to play a prominent part in the causation of the pneumonic process, is the presence within the alveoli of the inflammatory products of the bronchial mucous membrane. Such products are frequently found in the lungs in cases of broncho-pneumonia. They occur in scattered groups of air-vesicles, and are evidently inhaled. They are found both in the air-containing and in the collapsed portions of the lung, but especially in the latter, the presence of collapse necessarily interfering with their removal by expectoration or absorption. These inhaled products are often found filling small groups of alveoli *without any evidence of subsequent inflammation*, and there can be no doubt that many of the patches of consolidation which are usually described as pneumonic are in reality non-inflammatory in their nature, and are thus produced. At the same time, owing to the irritation of the inhaled secretion, it tends to induce inflammatory changes within the alveoli, and these changes are frequently largely owing to its presence. Juergensen accounts for the pneumonic process occurring in isolated spots in the collapsed lung by regarding the inflammation as being determined by the inhaled bronchial secretion.

2. *Broncho-pneumonia independent of collapse.* Although the pneumonic process is usually consecutive to collapse it may occur independently. This may be owing either to the direct extension of the inflammation from the bronchi to the air-vesicles, or to the influence of inflammatory products inhaled from the bronchi. In other cases it is possible that the injury which causes the bronchitis causes at the same time the inflammation of the pulmonary alveoli.

Symptoms.—The symptoms of broncho-pneumonia are, to a great extent, those of capillary bronchitis. They vary according to the severity of the bronchitis, and according as this is associated or not with other disease. In the severe forms of capillary bronchitis of childhood, and in that associated with measles, the implication of the lung usually gives rise to early and marked symptoms, and the disease runs a comparatively acute course. In the less severe forms of bronchial catarrh, on the other hand, and in that associated with whooping-cough, the supervention of a pneumonic process commonly occurs later; the symptoms are less pronounced; and the course of the disease is much more chronic. Although various gradations are met with between these more acute and the chronic forms, it will be advisable, for the sake of description, to consider them separately.

Acute broncho-pneumonia.—The more acute forms of broncho-pneumonia occur especially as a complication of measles, and in the simple capillary bronchitis of childhood. In measles the pneumonic process commonly supervenes towards the end of the first, or beginning of the second week, but it may be much later.

The early symptoms are those of severe catarrh of the smaller bronchi—pyrexia, frequent cough, accelerated respiration, slight action of the nares, &c. Such symptoms precede, for a varying length of time, those due to the implication of the lung-tissue. The earliest symptoms of the pneumonic process are by no means well-defined, and consequently the time at which the lung becomes involved cannot be fixed with certainty. Rigors and vomiting are but rarely observed.

Usually an increase in the acceleration of the respiration, or in the dyspnœa, are the first signs of the pulmonary implication. The breathing becomes very rapid, and commonly causes much distress, the child tossing about and being exceedingly restless. This dyspnœa is more marked at some times than at others, and is occasionally more or less distinctly paroxysmal. The respiration is superficial, inspiration being short, and the expansion of the thorax imperfect. There is marked action of the accessory respiratory muscles, and the upper portions of

the thorax are raised, whilst the lower are retracted during the inspiratory act; the action of the nares is very pronounced.

An increase in the pyrexia which attended the pre-existing bronchitis is, with few exceptions, observed as the lungs become involved, and such increase is to be regarded as one of the most valuable indications of the existence of a pneumonic process. The maximum temperature of acute simple bronchitis is seldom higher than 102° Fahr., whereas that of the secondary pneumonic process is often 104° or 105°. This increase usually occurs more or less gradually; —there is rarely the sudden rise of temperature met with in acute pneumonia. Unlike the temperature of this disease also, the fever of broncho-pneumonia runs no definite course. It varies with the extent of the lung-implication, and with the rapidity with which this implication is effected. There is no regular diurnal variation; the remissions and exacerbations are often considerable; and they occur at irregular times, the temperature being sometimes higher in the morning than at night. The cough, which before the implication of the lung was paroxysmal in character, gradually becomes less and less so, and it now often causes much pain to the patient. The sputa are bronchitic in character, usually very tenacious, and occasionally streaked with blood; as, however, expectoration rarely occurs in the child, they are not often seen. The pulse is much increased in frequency, in children under five years often being 150. It may in the earliest stage of the disease be moderately full and strong, but it quickly becomes soft, small, and feeble. In addition to the above, there are often symptoms referable to the digestive organs. Of these diarrhœa is the most important. This is quite frequent, especially when the disease follows measles. It is very readily induced by medicines and by improper feeding; and as it greatly weakens the patient, it is important that this liability to it should be kept in mind. Vomiting, as already stated, is very rare as an initial symptom; it is, however, common in the course of the disease, especially as a result of cough, the bronchial secretion, together with the contents of the stomach, often being expelled.

As the implication of the lungs increases, the breathing becomes still more rapid and superficial; the dyspnœa is more marked; the expression is anxious; the face is pale; and symptoms of carbonic-acid-poisoning become evident. Strength now fails; the face and lips become cyanotic; and the extreme restlessness gives place to apathy and a semi-comatose condition, which is interrupted from time to time by ineffectual efforts to cough. With the rapid failure of strength and increasing cyanosis, cough almost ceases; the pulse becomes exceedingly feeble; and the child, often extremely emaciated, may die exhausted, and in a condition of more or less profound coma. Sometimes death occurs suddenly during a paroxysm of cough, or with convulsions.

Chronic broncho-pneumonia. —The symptoms of the more chronic forms of broncho-pneumonia, such as occur especially after whooping-cough, and also after bronchial catarrh of moderate severity, differ somewhat from those of the acute disease. The pneumonic process commonly supervenes later, and the course of the disease is much more protracted. As in the acute forms, pyrexia and increased frequency of respiration are the earliest indications of the pulmonary implication. In these cases, however, there is usually but little if any fever prior to the pneumonia; it comes on very gradually; and the maximum temperature is much lower than in the more acute forms, commonly not being more than 102° Fahr. The course of the pyrexia also is still more irregular, lengthened periods of very slight fever being interrupted from time to time by slight exacerbations. Loss of appetite, great emaciation, increasing difficulty of breathing, and loss of strength, characterise the disease. Such symptoms may continue for months, and the child ultimately die, or recover with more or less damaged lungs.

When broncho-pneumonia occurs in adults and in the aged, the symptoms are for the most part much less pronounced than in the child. In strong adults the disease is perhaps most common after diphtheria, and here the pulmonary symptoms may be well-marked; but in the debilitated, and especially in the old, the course of the disease is much more latent, very slight pyrexia (100° Fahr.), slight cough and dyspnœa, and marked debility being the principal symptoms observable.

In the aged and feeble, broncho-pneumonia is very frequently associated with that form of lung-consolidation which results from weak inspiratory power, feeble circulation, and gravitation (hypostatic pneumonia). It has already been stated that this consolidation, which consists mainly of collapse, hyperæmia, and œdema of the lung-tissue, favours a catarrhal swelling and proliferation of the alveolar epithelium. Hypostatic consolidation may exist quite independently of bronchial catarrh; but when such catarrh occurs in the aged and feeble, gravitation often determines the supervention of the pneumonic process, which under such circumstances is consequently not infrequently unilateral.

When the more acute varieties of broncho pneumonia terminate fatally, they usually do so from the tenth to the fourteenth day of the disease. Death, unlike that from acute pneumonia, is mainly due to the interference with the respiratory function and, to a much less extent, to failure of cardiac power (Juergensen). The interference with the respiration is much greater than in acute pneumonia, for, in addition to the diminution of the respiratory area, due to the pulmonary consolidation and collapse, there is the much more important cause of interference—namely, the impediment to the entrance of air, caused by the swelling of the bronchial mucous membrane, and the accumulation of secretion in the bronchial tubes. These interferences with respiration necessitate increased action of the respiratory muscles; but with the progress of the disease these muscles become weakened, partly by the fever, and partly from the imperfect supply of oxygen. With this failure of respiratory power the incompleteness of oxygenation necessarily increases, until the supply of oxygen may become so small as to lead

to complete muscular paralysis. The damage to the heart, as in acute pneumonia, is due partly to the diminished respiratory area, and partly to the fever; but this damage is a much less important element in the causation of dissolution in broncho-pneumonia, than it is in the general disease. (Juergensen). In chronic broncho-pneumonia death may not occur for some months, and then it results as much from general failure of strength as from interference with the respiratory function.

When the disease does not terminate in death, improvement in the symptoms is always gradual. The temperature falls slowly, several days, and occasionally some weeks, being occupied in the completion of defervescence; and this gradual decline is usually interrupted by more or less marked and frequent exacerbations and remissions of the fever. The cough and dyspnœa diminish, and the appetite gradually returns; but restoration to health is always protracted; and the child remains for some time especially liable to repetition of the bronchial symptoms.

Sometimes recovery from the broncho-pneumonia is not complete, andthe disease leads to induration of the lung, dilatation of the bronchi, &c. (*see* Chronic Pneumonia). Emphysema and acute tuberculosis are occasional sequelæ. That the disease sometimes terminates in phthisis, especially in children and in those who inherit weak lungs, appears to the writer to be indisputable.

Physical signs.—The physical signs of broncho-pneumonia are in the main those of capillary bronchitis. Imperfect expansion of the thorax, elevation of the upper portions, and recession of the lower, during the inspiratory act; moist and dry *râles*, audible over both sides; and the absence of any marked alterations in percussion-resonance, are the principal signs observable, not only in the earlier stages, but throughout the whole course of the disease. The recession of the chest-walls is increased by collapse. The supervention of the pulmonary implication is indicated rather by the symptoms—increase in the pyrexia and in the dyspnœa—than by any marked alteration in the physical signs. The difficulty of detecting the lung-consolidation is due to its usually being limited, in the earlier stages, at all events, to small areas, which are surrounded by healthy or emphysematous lung, so that resonance on percussion is but little impaired. It is only when these small areas have coalesced into larger areas of consolidation, that any marked alterations in percussion-resonance are discoverable. The impaired resonance due to collapse is not to be distinguished from that due to pneumonic consolidation; and, inasmuch as the collapse is so often symmetrical, involving both bases posteriorly, the difficulty of appreciating it is increased. Much more valuable aid in physical diagnosis is in most cases to be obtained from auscultation. Over those portions of the lung where consolidation has taken place the moist bronchitic *râles* tend to assume a somewhat metallic quality; they also become finer, though not so fine as true pneumonic crepitation; and they are more superficial. The detection of these superficial, somewhat metallic fine moist *râles*, heard with inspiration, and often with expiration, over small areas of the lungs, is a most valuable and often the only physical sign of the pulmonary implication. If large areas become consolidated, there is, in addition to this, some impairment of resonance on percussion.

Complications.—These are few. It is scarcely necessary again to state that bronchial catarrh is always present. Pleurisy is less common than in acute pneumonia. Slight inflammation of the pleura is, however, usually found *post mortem*, over those portions of the lung which are consolidated. Pleuritic effusion is rare. Intestinal catarrh is a very important and common complication. The liability to this in the child, and the mechanical congestion resulting from the obstructed pulmonary circulation, must be borne in mind in explaining its frequency.

Convulsions occasionally occur, and are of unfavourable augury. The nervous phenomena in some few cases have been described as simulating those of tubercular meningitis. Catarrhal laryngitis, associated with much spasm and laryngeal stenosis, is sometimes observed, especially after measles.

Diagnosis.—The diagnosis of broncho-pneumonia is occasionally difficult. This difficulty is mainly owing to the co-existence of capillary bronchitis. The recognition of the pulmonary implication in its earlier stages is often impossible. The increase in the pyrexia, and in the frequency of respiration, are the symptoms of the most diagnostic value. Owing to the small areas of lung involved, any alteration in the physical signs of the capillary bronchitis may be entirely wanting. The occurrence of extensive collapse in the earlier stages gives more marked physical signs of consolidation, and hence renders the diagnosis more easy. It is almost impossible to diagnose certainly, either by symptoms or by physical signs, between the collapse and the pneumonic consolidation. This, however, is of but little practical importance, inasmuch as the collapse is usually associated with, and often the immediate precursor of, the pneumonic process.

The diagnosis of broncho-pneumonia from the pulmonary consolidation of acute pneumonia may occasionally be difficult in the later stages of the former, when an extensive area of the lung has become consolidated. The history of the case, and especially the course of the pyrexia, will usually suffice to distinguish them.

The distinction from acute tuberculosis sometimes presents much difficulty, as does also the recognition of tuberculosis and phthisis as an occasional result of the disease. A careful consideration of the earlier symptoms, and the existence or not of marked predisposition, are here most important. Slight and irregular pyrexia, existing before the supervention of lung-symptoms, is greatly in favour of tuberculosis. In some cases, however, the phenomena of these diseases are so analogous that a certain diagnosis is impossible.

Prognosis.—Broncho-pneumonia is much more dangerous than the acute primary disease, and the mortality from it is much greater. The more chronic forms are more fatal than the acute. The two circumstances which have an especial influence upon prognosis are the age of

the patient, and the general health. Before puberty, the younger the patient the graver the prognosis. In children under five years, the mortality is exceedingly great (probably about 20 per cent.) The disease is also especially fatal in weakly children, and in all those who are constitutionally feeble, or debilitated by previous illness. The existence of rickets materially increases the gravity of prognosis. The danger also increases greatly with the extent of lung involved, much more so than is the case in acute pneumonia. Of the value of the several symptoms as influencing prognosis, after the description which has been given of the disease and of the modes in which it tends to cause death, it is hardly necessary to speak further. Symptoms of imperfect aëration of the blood are those most to be feared.

Treatment.—In the treatment of broncho-pneumonia, it is important to bear in mind:—1st, that the disease is invariably associated with, and is in the main induced by bronchial catarrh, and by its so frequently attendant collapse; 2ndly, that its occurrence is especially favoured by everything that weakens the patient; and 3rdly, that it tends to destroy life principally by interfering with the function of respiration, which interference necessarily increases with the consequent weakening of the respiratory power. Such being the facts, it is obvious that the main object of treatment will be, first, to control bronchial catarrh, and endeavour so to modify it as to prevent the occurrence of collapse; and, secondly, to support as much as possible the strength of the patient, with the object of preventing not only collapse, but also that increased interference with the function of respiration which results from weakening of the respiratory muscles.

It would be out of place in the present article to enter into a detailed description of the management of acute bronchitis (*see* Bronchi, Diseases of). It will be sufficient to indicate the more important means of controlling the disease, with especial reference to the prevention of the so frequently attendant collapse.

The patient should be kept in a warm room, the temperature of which should never be allowed to fall below 60° Fahr. The room should be well, but carefully ventilated; and protection from draughts is important, much more so than in the treatment of acute pneumonia. It is also advisable to keep the air moist by means of a steam kettle, as the exhalation of water from the lungs is thus diminished, and the bronchial secretion consequently rendered less tenacious, and more easily removed by cough. The diet, which must be regulated according to the age of the patient, should be nutritious and easily digestible, the importance of supporting the strength being kept in mind. When the disease follows measles, the liability to gastro-intestinal catarrh must not be forgotten. Small doses of ipecacuanha with salines should be administered frequently. The chest should be enveloped in lightly made linseed and mustard poultices; or, what in the case of very young children answers better, it should be rubbed three or four times daily with some stimulating liniment, and kept wrapped in cotton-wool covered with oil-silk. When the secretion in the tubes is abundant, its removal may be much aided by small doses of carbonate of ammonia. This may be either combined with the ipecacuanha and saline mixture, or given separately in a little milk. Senega, as an infusion, and chloride of ammonium may also be given with the same object. The last-named drug appears to have the effect not only of rendering the secretion less tenacious and more easily removable, but also of diminishing its formation. An occasional emetic dose of ipecacuanha often materially relieves the patient, when numerous *râles* audible over the chest, and increased dyspnœa, indicate an accumulation of the secretion. This, however, must not be given when there is marked exhaustion present. The exhibition of opiates is as a rule contraindicated. When the cough is feeble, and the secretion abundant, they do much harm. In the more chronic forms of the disease, however, and especially when following whooping-cough, where the cough is often violent, and there is but little bronchial secretion, opiates may be cautiously given with advantage, as may also bromide of ammonium.

With the object of reducing the temperature, and also of increasing the expansion of the lungs, much may be done by the external application of cold. This method of treatment appears to be especially valuable in increasing the depth and force of respiration, and thus in preventing the occurrence of collapse. Its utility has been strongly advocated by both Bartels and Ziemssen. The method recommended by these physicians consists in the application of cold wet compresses round the chest, which treatment may be continued from half to three or four hours. It is often necessary to repeat the application at intervals for some days, as the beneficial effect is only temporary. This treatment produces a marked reduction of the temperature, and also a diminution in the frequency, but an increase in the depth, of the respirations; the distress being thus considerably relieved, and the patient often falling into a sound sleep. Owing to the depression produced by the cold if too long continued, its effects require to be watched, and when symptoms of exhaustion appear, the cold should be discontinued, to be renewed again subsequently.

Another method of treatment by cold is that recommended by Juergensen, and considered by him very preferable to the preceding, as being more effectual and causing less discomfort. This is a treatment by baths and cold affusion. The child is first placed in a bath at a temperature of from 77° to 86° Fahr. for twenty minutes; and then from 10 to 20 quarts of water at 36° Fahr. are to be quickly thrown over the back and chest. This causes several deep respirations, and thus is valuable in preventing collapse; but it appears to have less effect in reducing temperature than the treatment by cold compresses.

Whilst these various means are being employed, it is all-important to support the strength of the patient. Brandy is here most valuable, and it is to be remembered that children bear stimulation well. The brandy is

best given in milk, the quantity being proportioned to the age of the patient. An infant may begin with from five to ten drops every two or three hours. Under its influence the pulse usually improves, the respirations become less frequent, and the distress and cyanosis diminish. The administration of brandy is usually advisable before and during the treatment by cold. When prostration is extreme, or deglutition difficult, both the brandy and other nutriment may be administered by the rectum.

In the chronic forms of broncho-pneumonia these more active methods of treatment are but rarely called for. Here attention to nutrition is most important, and small doses of cod-liver oil in the later stages, even before the complete disappearance of the pyrexia, are often useful. When the disease leads to induration of the lungs and dilatation of the bronchi, the treatment resolves itself into that of chronic pneumonia.

Convalescence, it must be remembered, is always slow, and there is a tendency to relapse. Great care is consequently requisite during this period. All causes of catarrh must be carefully guarded against; and the restoration to health assisted by nutritious diet, cod-liver oil, and iron. A change of air is especially valuable.

D. **Chronic Pneumonia.**—Synon.: Chronic Inflammation of the Lungs; Cirrhosis of the Lung; Fr. *Pneumonie interstitielle*; Ger. *Lungencirrhose.*

Definition.—Chronic pneumonia is a comparatively rare disease, characterised by a gradual increase in the connective tissue of the lung, which leads to an induration of the pulmonary texture, and to progressive obliteration of the alveolar cavities. It is commonly associated with catarrh and dilatation of the bronchi, and often with ulceration of the bronchial walls, and excavation of the indurated lung. Cough, expectoration—often abundant, but varying with the bronchial catarrh—dyspnœa, gradual impairment of nutrition, and occasional accessions of slight pyrexia, are the most prominent clinical phenomena accompanying the disease, which runs an exceedingly chronic course, often subject to long periods of quiescence, but tending to terminate fatally in from five to fifteen years.

Chronic pneumonia is also known as *interstitial* pneumonia. In its most marked form it constitutes the disease which received from Corrigan the name of *cirrhosis*. The term 'fibroid phthisis,' which is sometimes applied to it, is altogether inapplicable.

Ætiology and Pathology.—It is exceedingly doubtful if chronic pneumonia is ever a primary and independent disease. It probably in all cases owes its origin to some antecedent inflammation of the pulmonary or bronchial textures, or of the pleura. It may be stated generally that all inflammatory processes in the lungs, as in other organs, which become chronic, lead to an increase of the connective-tissue elements, and consequently to fibroid induration of the organ. In the lungs by far the most common cause of such induration is pulmonary phthisis. In all cases of phthisis, excepting those which are the most acute, there is more or less fibroid growth; and the extent of this growth is, for the most part, in direct proportion to the chronicity of the disease. Those forms of phthisis which are the most chronic, and in which the fibrosis reaches its maximum, have been termed 'fibroid phthisis.' The most chronic cases of phthisis are, it must be admitted, somewhat closely allied to some forms of chronic pneumonia. The two diseases, however, differ pathologically in this respect—that whereas much of the pulmonary consolidation of phthisis tends to undergo molecular death and disintegration, that of chronic pneumonia exhibits no such tendency; but any destruction and excavation of the indurated lung which may take place, is due to secondary inflammation and ulceration commencing in the bronchial walls. In considering the pathology of chronic pneumonia, therefore, it is necessary to exclude in the first place the pulmonary induration of phthisis. Chronic pneumonia must also be separated from that form of pulmonary induration which is produced by long-continued mechanical congestion, namely, brown induration; and from those more localised indurations due to bronchitis, peri-bronchitis, old infarctions, and syphilis.

There appear to be four conditions which may give rise to chronic pneumonia, namely:—1. *Acute pneumonia.* 2. *Broncho-pneumonia.* 3. *Pleurisy.* 4. *The inhalation of irritating particles of solid matter.* Each of these must be considered separately.

1. *Acute pneumonia.*—Chronic pneumonia is an occasional, though quite rare, result of the acute primary disease. The pulmonary consolidation of acute pneumonia almost invariably undergoes complete resolution. This resolution is usually effected rapidly, in from seven to fourteen days. Occasionally, however, the course of the disease is more protracted, and the consolidation persists beyond the third week. When thus protracted, the hepatised lung tends to become slightly indurated, owing mainly to thickening of the walls of the alveoli. This indurated hepatisation differs but little in its physical characters from ordinary red and grey hepatisation; it is simply somewhat firmer and more resistant. In very exceptional cases this small amount of induration commencing in the alveolar walls may gradually increase, so as ultimately to give rise to that extensive fibrosis of the lung which constitutes what is known as chronic pneumonia.

2. *Broncho-pneumonia.*—Broncho-pneumonia appears to be a somewhat more frequent cause of the disease than the preceding (Wilson Fox). The greater liability of this form of pneumonia to lead to pulmonary induration is to be accounted for partly by its longer duration and greater tendency to become chronic, and partly by the existence of bronchial dilatation with which it is so frequently associated. That bronchial dilatation is favourable to an indurative pneumonic process has been especially insisted upon by Dr. Wilson Fox. Dilatation of the bronchi is exceedingly common in the simple bronchitis of childhood, and especially in that associated with whooping-cough and measles; it is also a direct result of pulmonary fibrosis. In whatever way originating, its existence favours the persistence of the catarrhal and pneumonic processes. The removal

of secretion is rendered more difficult; the retained secretion tends to increase and keep up the irritative process, both in the dilated bronchi and also in the pulmonary alveoli; and this persistence of the bronchial and pulmonary inflammation leads to fibroid thickening of the bronchial and alveolar walls. In this way more or less disseminated patches of indurative consolidation are produced, which as the process proceeds gradually increase, so that ultimately they may involve large areas of the lung. The progressive tendency of the process is probably partly to be explained by the fact, already stated, that pulmonary fibrosis is a cause of bronchial dilatation, so that fibrosis once established, by inducing further dilatation of the bronchi, favours the extension of the bronchial and pulmonary inflammation.

3. *Pleurisy.*—Pleurisy in very exceptional cases leads to the development of a chronic pneumonia. It appears to be in those cases of pleurisy which are more or less chronic, and in which the lung remains long collapsed from the effusion, that such a result is most liable to occur. The induration of the lung thus induced is often, however, exceedingly partial, consisting merely in some increase of the interlobular connective tissue originating and extending inwards as dense bands from the thickened visceral pleura. In other cases pleurisy probably gives rise to a much more general fibrosis.

4. *Inhalation.*—The inhalation of irritating particles, such as occurs in the trades of miners, potters, stone-masons, grinders, &c., is the cause of the fibrosis of the lungs common amongst persons so employed. The continuous irritation of the inhaled particles induces a bronchial and alveolar inflammation, and ultimately fibrous growth in the bronchial and alveolar walls, which, gradually extending, may involve large areas or even the whole of the lungs.

Anatomical Characters.—The histological changes met with in the lungs in chronic pneumonia may be described generally as consisting in the development of a fibro-nucleated tissue from the walls of the alveoli, from those of the bronchi, and from the interlobular connective tissue; which new growth, as it increases, and from its tendency to contract, gradually replaces and obliterates the alveolar structure. The character of these changes, however, varies somewhat according to the inflammatory antecedents in which they originate. When chronic pneumonia is the result of acute pneumonia, the principal change takes place in the walls of the alveoli. These become thickened by the growth of a small-celled tissue, in which, associated with the spheroidal cellular elements, there are sometimes elongated fusiform cells, such as are found in embryonic tissue which is in process of forming a fibrous structure. This new growth, in its earlier stages, usually contains new blood-vessels; but later the tissue contracts, and the vessels become to a great extent obliterated. The growth differs from the non-vascular growth of phthisis, inasmuch as it has but little tendency to undergo molecular death and disintegration. The alveolar cavities, where not obliterated, are either empty, or contain exudation-products and a few epithelial cells.

When secondary to ordinary broncho-pneumonia, or to that induced by the inhalation of irritating particles, the new fibroid growth also originates principally from the alveolar walls. Here, however, the growth in the earlier stages is less uniform, and the peri-bronchial and interlobular connective tissues play a more prominent part in the process. The new peri-bronchial tissue invades the walls of the adjacent alveoli, and materially increases the fibrosis.

In the chronic pneumonia resulting from pleurisy, the change, as already stated, is often more localised, consisting in the development of dense fibrous bands passing inwards from the thickened pleura. These are developed from the interlobular tissue. In other cases the fibrosis is more general.

In whichever of the pulmonary structures the new fibroid growth originates, as it increases, all the connective tissue of the lung may become involved, and the alveolar cavities be completely obliterated. The new growth, like that met with in the inflammatory indurations of other organs, although in the earlier stages of its development it may be richly cellular and contain new blood-vessels, tends gradually to become less cellular, denser, and more contractile. In its more advanced state it often consists either of closely packed wavy fibres, or more frequently of a dense homogeneous or obscurely fibrillated material, associated with which are a few small round or fusiform cells. Sometimes the new growth is found richly cellular, even in the most advanced stages of the disease.

The macroscopical appearances of the lung vary with the extent of the fibroid change. In the earliest stages of the induration resulting from acute pneumonia, where there is merely a slight thickening of the walls of the alveoli, the consolidation very much resembles that of red or grey hepatisation. It differs in being firmer and less friable in consistence, and is somewhat less granular. In the later stages, and in all cases where the fibrosis is extensive and general, the lung is diminished in size, dense, firm, fibrous, and even cartilaginous in consistence. The cut surface is smooth; and the large amount of irregularly distributed black-pigment usually present, gives to it a peculiar grey, marbled appearance. Numerous dilated bronchi traverse it in all directions.

When the disease is secondary to broncho-pneumonia the fibrosis in the earlier stages is much less general, as it usually is also when the result of pleurisy. Sometimes dense tracts of fibrous tissue are found intersecting the lung in various directions. As the disease advances, however, a large area, or even the whole lung, may become involved.

The bronchi are almost invariably found dilated in those portions of the lung where the induration is advanced. In some cases some dilatation of the tubes is observed in parts which are not involved in the induration. This dilatation is often very considerable, and the dilated tubes sometimes form large cavities, which may occupy a large portion of the indurated lung. The walls of the tubes are much thickened, and the mucous membrane is often ulcerated. This secondary inflammation and

ulceration of the bronchi occurs especially in the dilated portions, and it appears here to be induced by the irritation of the retained and putrid secretion. It may extend into and involve the indurated lung, and so lead to more or less excavation. The mucous membrane sometimes sloughs, and the gangrenous process may involve the lung. The large cavities so common in these lungs are in the main, however, dilated bronchi. *See* Bronchi, Diseases of.

The pleura of the affected lung, except in the earliest stages of the disease, is much thickened and adherent.

Site.—Chronic pneumonia is in the majority of cases unilateral. The whole lung may be involved or only a portion. In the latter case the base is much more commonly affected than the apex. When due to the inhalation of irritating solid particles, both lungs are usually implicated.

Symptoms.—In the earlier stages of chronic pneumonia the symptoms are often very obscure, and it is not uncommon to meet with advanced and extensive fibrosis in which the lung-affection must presumably have been of much longer duration than the symptoms accompanying it. In some cases the symptoms are directly continuous with those of some more acute pulmonary inflammation—an acute or a broncho-pneumonia. Under these circumstances a prolongation of some of the phenomena of the original disease indicates the supervention of the pulmonary fibrosis. The pyrexia does not entirely disappear. There may be merely slight elevation of temperature towards evening, or the course of the fever may be very irregular. The cough usually persists, as does also some increase in the frequency of the respiration and pulse; and the patient, instead of improving, gradually loses strength and flesh. At the same time the physical signs of the pulmonary consolidation remain, and gradually give place to those of pulmonary induration. Where chronic pneumonia is secondary to pleurisy, a continuous sequence in the symptoms is less commonly observed. When the result of the inhalation of irritating solid particles, the symptoms of bronchial catarrh are predominant.

When the fibrosis is fully established the symptoms are usually more pronounced. They vary considerably, however, according to the extent of the lung involved, the quiescence or activity of the indurating process, and the presence or absence of bronchial catarrh. When bronchial catarrh is absent, and the disease is perfectly quiescent, a considerable area, or even the whole of the lung, may be involved without producing any marked pulmonary symptoms, and slight dyspnœa, with some general impairment of nutrition and failure of strength, may be almost the only phenomena present. Such quiescence and immunity from symptoms, however, although common in the course of the disease, is rarely observed over very lengthened periods.

With the existence of catarrh of the bronchi, much more marked symptoms are observable. Inflammation of the bronchi is especially favoured by the dilatation of the tubes, and it is almost invariably present, to a greater or less extent, during the course of the disease; with it is usually associated activity of the indurating process. The dilatation of the bronchi and secondary ulceration of their walls, which are so frequent, are also most important factors in accounting for the symptoms. The course of the disease now often simulates that of chronic phthisis, but it is for the most part more chronic, less regularly progressive, and more frequently interrupted by periods of quiescence. The dyspnœa is now more marked, and cough becomes a troublesome symptom. The cough may be more or less constant, and it is usually attended by expectoration. Its characters vary, however, according to the extent of bronchial dilatation and excavation. When there are numerous dilated bronchi in the lower portions of the lung, the secretion accumulates within them, and its removal by expectoration becomes exceedingly difficult. Under these circumstances the cough is violent and paroxysmal. The patient may remain for several hours with but little or no cough, and then occurs a violent paroxysm, which results in the expectoration of large quantities of muco-purulent secretion. This violent paroxysmal cough and copious expectoration, occurring at long intervals, are exceedingly characteristic of bronchial dilatation in the lower portion of a lung. According to Niemeyer, the paroxysm occurs when the secretion which accumulates in the lower portions of the lung reaches and irritates the more healthy bronchi which retain their sensibility, the dilated tubes being so altered as to be completely insensible. The sputum may be simply puriform, but when there is much bronchial dilatation, owing to its accumulation and retention in the tubes, it usually undergoes putrefaction. It then often has a greyish or greenish-black colour, and is usually more or less fœtid. This fœtor exists quite independently of gangrene, although it is more marked when gangrene is present. Hæmoptysis is not unfrequent, but it is usually small in quantity. It is probably in most cases due to ulceration of the bronchial walls.

Pyrexia is usually present to a greater or less extent in the course of the disease. The fever, however, is exceedingly irregular, and there are often long periods of perfect immunity. During the pyrexial periods the maximum evening temperature is rarely more than 101° or 102° Fahr., and it may be only 100°. The morning temperature is often normal. The pyrexia appears in most cases to be due to inflammation and ulceration of the bronchi, and to the activity of the indurating process.

With the progress of the disease the patient gradually emaciates. The digestion becomes impaired, and diarrhœa is often present. Dropsy is a common symptom, although it is rarely extensive, and is, for the most part, confined to the lower extremities. It appears in most cases to be due to the anæmia and impeded pulmonary circulation. The pulmonary obstruction may also give rise to some enlargement of the right side of the heart, and cyanosis. Lardaceous disease of the viscera is occasionally met with. Death usually results from the general failure of strength, or from some intercurrent affection of the opposite lung.

Physical signs.—In the earliest stage of

chronic pneumonia, when it is the result of a more acute pneumonic process, the physical signs are, in the main, those met with during the acute consolidation. It is the persistence of the signs of the pulmonary consolidation after the acute attack which indicates the possibility that the disease may become chronic. Dulness on percussion; increased vocal fremitus; bronchial breathing; and the existence of *râles*, which are larger, moister, and more metallic in quality than those of fine crepitation, are observable during this stage. When the induration is fully established, the physical signs are those of contraction and consolidation, with usually those of more or less dilatation of the bronchi, of a whole or a portion of the lung. The retraction is well-marked, and commonly affects the whole side, although when the lung is not universally involved it may be more limited. Expansion is exceedingly deficient, or completely absent. The heart is much displaced towards the affected side; the diaphragm and the abdominal viscera are drawn up; and the opposite lung encroaches considerably across the middle line in front. Percussion is hard, wooden, and high-pitched, sometimes more or less amphoric. The vocal fremitus is usually increased; and there is often bronchophony or pectoriloquy. The respiratory sounds will vary according to the extent of the bronchial dilatation and excavation, and the amount of secretion. They are for the most part bronchial; usually large and loud; and often distinctly cavernous. When there is much secretion in the dilated bronchi, high-pitched bubbling *râles* are heard, which are often amphoric and cavernous. These may be audible only after cough. The opposite lung is usually hyper-resonant, and the respiration exaggerated.

Diagnosis.—The diagnosis of chronic pneumonia rests mainly on the physical signs. The diseases with which it is most liable to be confounded are chronic phthisis, and retraction from pleurisy. In the most chronic forms of phthisis, where the fibrosis of the lung is considerable, the diagnosis from non-phthisical consolidation may present some difficulty. This difficulty, however, rarely exists except in those cases in which the chronic pneumonia involves only the upper portions of the lung. Here the situation of the consolidation is very greatly in favour of its phthisical nature. This probability is infinitely increased if the other lung be affected. In unilateral basic disease, and in induration of the whole of one lung, the other lung being healthy, the question of phthisis can rarely present itself. Disease of the larynx is in favour of the phthisical, fœtidity of the sputa of the non-phthisical nature of the consolidation.

The retraction resulting from pleurisy with effusion may also be occasionally confounded with chronic pneumonia. Here, however, there are rarely the physical signs of dilatation of the bronchi, and the vocal fremitus is more commonly diminished. The presence of abundant fœtid sputa, of pyrexia, emaciation, &c., in chronic pneumonia will also in most cases render the diagnosis easy.

Prognosis.—Chronic pneumonia, when it involves a considerable area of the lung, usually tends ultimately to terminate in death, although under favourable circumstances life may be prolonged for many years. When the induration is more limited, and remains quiescent, the general health and duration of life may sometimes be but little affected. The most important element in the prognosis is the condition of the bronchi. The existence of bronchial inflammation, as evidenced by profuse expectoration, is always unfavourable, as it not only weakens the patient, but is usually attended by extension of the induration, and ultimately leads, in the dilated tubes, to ulceration of the bronchial walls and surrounding tissue, and occasionally to gangrene. Pyrexia, as another evidence of inflammation of the bronchi and indurated lung, is likewise unfavourable, as is also hæmoptysis. The latter indicates deep ulceration, and it may in exceptional cases endanger life. The general condition of the patient must also be taken into account in making a prognosis. Failure of strength and of digestive power, diarrhœa, and dropsy, are all of unfavourable augury.

Treatment.—In considering the treatment of chronic pneumonia, it is in the first place important to bear in mind that the usual origin of the disease is some more acute pulmonary inflammation. Hence the necessity for the most careful management and supervision of such inflammations in their later stages, with the object of procuring a complete resolution of the pneumonic products.

When the fibrosis of the lung is established, it is hardly necessary to remark that the new growth is incapable of removal, and by treatment we can only hope to influence the extension of the disease, and control the bronchial catarrh with which it is so frequently associated. The frequency and gravity of bronchial catarrh has been already insisted upon, and its management, in the majority of cases, constitutes the most important element in the treatment. In that class of cases in which the disease owes its origin to the inhalation of irritating particles of solid matter, the removal of the patient from the source of irritation is obviously called for.

In the attempt to prevent and control bronchial catarrh, the question of climate must necessarily present itself, and very much may usually be done by residence at some suitable station. One not subject to vicissitudes of temperature, and at the same time dry and moderately bracing, is most likely to be beneficial. The patient should be warmly clad, and everything should be done, by means of diet and medicine, to improve the general health, inasmuch as the better the state of nutrition, the less is the liability to bronchial inflammation. Cod-liver oil and iron are often useful for this purpose. If an attack of acute bronchial catarrh supervenes it should be treated at once, and the importance of quickly controlling it should not be forgotten. In the medicinal treatment of the more chronic catarrhal process, which is so often associated with profuse secretion, much may usually be gained by the use of inhalations, of which turpentine, creasote, iodine, and carbolic acid are, perhaps, the most generally useful. These not only tend to diminish the amount of

secretion, but induce coughing, and so assist in its evacuation. They also materially lessen fœtor. Turpentine may be administered internally with the same object. When the cough is excessive and prevents sleep, opium and chloral are most valuable. Counter-irritation, especially inunctions with iodine, appear sometimes to be serviceable. Gastric disturbance, diarrhœa, hæmoptysis, &c., must be treated, as they arise, on general principles.

T. Henry Green.

LUNGS, Inflation of.—This term is used somewhat ambiguously. It is sometimes employed as synonymous with emphysema in its general sense. More correctly it has been limited to that condition in which the lungs are acutely and temporarily distended more or less with air from various causes, such as plugging of the bronchial tubes, a condition which is usually called 'acute emphysema.' It cannot be said to give rise in itself to any definite symptoms; but it can be made out by physical examination, the signs being those indicating excess of air in the lungs.

When this condition exists, the aim in treatment should be to get rid of any obstruction leading to the imprisonment of the air, and to help the lungs in expelling it. It must be remembered that, even after a considerable degree of distension, the lungs may return to their normal dimensions.

Inflation is also a term applied to that expansion of the lungs with air, which is aimed at in the practice of artificial respiration.

Frederick T. Roberts.

LUNGS, Malformations of.—There are no malformations of the lungs which can be regarded as of much importance from a clinical point of view. As anatomical peculiarities, the shape of these organs, or the arrangement of their lobes, may be abnormal. In a case which came under the notice of the writer, one of the lungs was improperly developed and unexpanded, in connection with the almost complete absence of one of the divisions of the pulmonary artery. The form of the lungs is frequently more or less altered, as the result of various organic diseases of these organs. Frederick T. Roberts.

LUNGS, Malignant Disease of.—Synon.: Fr. *Carcinome du Poumon*; Ger. *Lungenkrebs*.

Definition.—Malignant disease affecting the pulmonary tissues.

Ætiology.—Malignant disease of the lungs is of more frequent occurrence than was at one time supposed. But there are not sufficient trustworthy statistics to enable us to determine its relative frequency to other forms of thoracic organic disease. It has been met with in persons of all ages, from childhood to extreme old age; but the middle periods of life, from 20 to 60, are the most liable; and the two sexes are about equally obnoxious to the disease. As a primary disease, originating in the lungs, cancer is undoubtedly rare, though much less rare as first manifesting its presence in those organs, either by local or general symptoms. In by far the larger number of cases the disease in the lungs is a secondary affection, consequent on the transmission of cancer-cells, or blastema, from other parts; and in this way, with the exception of the liver, the lungs are more frequently implicated than any other internal organ. Thus, after the removal of an external cancer, pulmonary symptoms are among the most frequent and earliest indications that the disease has invaded internal organs.

Anatomical Characters.—The right lung has been considered to be more frequently affected with malignant disease than the left. This, however, does not accord with the writer's experience. Of thirty-nine cases tabulated by him, the left lung was the principal seat in fourteen, and the right in nine only, whilst of the remainder either both lungs were affected, or the disease was confined to the mediastinum. Of the several varieties of cancer encephaloid is by far the most common in the lungs; colloid and epithelioma are the rarest; and scirrhus holds a middle place. The intermediate varieties of these leading forms are also occasionally seen.

Symptoms and Diagnosis.—In proceeding now to describe the various aspects under which these several varieties are presented to the clinical observer, their natural history and diagnosis, it is not proposed to maintain any precise distinction between primary and secondary forms, nor to discuss the minute anatomy or general pathology of the several species, such questions having been considered in other parts of this work. The object of the writer is to treat the subject from a clinical point of view. It is important, however, to observe, *in limine*, that cancer may either commence in, or eventually implicate any or all of the pulmonary textures; although undoubtedly both the primary localisation and the spread of the disease are influenced by the particular species. Both the early symptoms and the subsequent progress of the case will often be materially modified by the particular tissue that is mainly implicated. If the disease first manifests itself in the form of sub-pleural growths, both the early symptoms and the subsequent phenomena will differ from those which present themselves when the disease commences in the deeper tissues of the lungs. And it is observable, that when the disease commences as disseminated deposits in the lungs, these deposits are frequently most numerous in the vicinity of the pleura, so that this membrane is very early implicated, in many cases, when it is not the primary seat of disease.

For clinical purposes we cannot do better than divide intra-thoracic cancerous growths into three groups. 1. Where the disease is *disseminated* through the lungs, either in the form of isolated scattered nodules of varying magnitude, or as spreading along the mucous membrane and sides of the bronchial tubes and vessels, through a greater or less extent of the lung. 2. Cases where the growth is more *localised*, occurring, for the most part, in large masses. 3. *Mediastinal tumours* involving the various structures at the root of the lungs, and eventually giving rise to symptoms of pressure and distress of a more or less serious character.

1. **Disseminated Malignant Disease.**—In the disseminated form of pulmonary cancer the symptoms vary considerably, according to the

seat of the growths. When the pleural surface is chiefly implicated, both the symptoms and the physical signs are essentially those of pleurisy, though the degree of febrile disturbance is usually very slight, and but little or perhaps no false membrane may be effused. The exudation is generally clear serum, or serum mixed with blood; and it may have a greenish or brown colour, but is rarely purulent or even semi-purulent. As the effusion increases in amount, the ordinary consequences of compression of the lung ensue, but dilatation of the side is generally much less marked than in simple pleurisy with effusion, in consequence of there being less giving way of the intercostals. The fluid generally returns speedily after paracentesis.

When the mucous and submucous membranes of the bronchi and the surrounding connective tissue are the chief seats of the disease, the physical signs are those of bronchial irritation and emphysema, which, however, may, for some time, be quite disproportionate to the dyspnœa and other symptoms of ordinary bronchitis. The expectoration is, for the most part, scanty, and either simply mucous or mixed with blood; or small bronchial casts may be expectorated. Examination with the microscope will occasionally reveal characteristic cancer-cells. The resonance of the chest may remain normal, when auscultation proves that there is a diminution of air entering the lung. But there will not be the hyper-resonance of emphysema. Wheezing and dry and moist sounds vary much with the amount of constriction of the tubes, and the amount and character of the secretion. But in advanced cases of this kind, by the spread of the disease along the interlobular septa and through the lung, its condition becomes similar to that of a cirrhotic lung, and the clinical aspects of the case may be greatly altered. Perhaps the most characteristic symptom of this class of cases is dyspnœa insidiously increasing, especially on exertion, without corresponding symptoms of either congestion of lung or compression. Of the general symptoms the most characteristic is that of steadily-advancing debility, which is common to other forms of cancer. And it is from asthenia, or from general cachexia, that the patient usually dies, before much or any disintegration of tissue takes place. It is the scirrhous variety of cancer which most often thus follows and implicates the bronchi.

In the distributive form, characterized by numerous masses, varying from the size of a millet-seed to that of a pea, scattered throughout the lungs, the clinical phenomena, both local and general, may very closely simulate those of tubercle, with recurrent attacks of bronchial irritation and congestion, and febrile disturbance. But as a rule, to which, however, some remarkable exceptions have been met with, there is little if any increase of temperature, nor is there the quickened breath and frequent dry cough of tubercle. The dyspnœa is chiefly on exertion, and seems more due to feeble circulation and general debility than to either pulmonary disease or febrile disturbance. Indeed the absence of local signs of inflammation, or symptoms of functional disturbance, are frequently remarkable. Signs of bronchial irritation in some of these cases have been early noted and prominent symptoms; in others they have been slight and variable. The apices of the lungs, though often implicated, are not specially and early invaded as in tubercle, but rather the bases. If the cancerous growths are rapidly developed and extensively distributed through the lungs, both the signs and general symptoms become greatly modified, and the case proves speedily fatal. The similarity to acute tuberculosis is sometimes very close, especially in those instances in which there is marked febrile disturbance, and recurring slight hæmoptysis.

2. **Localised Malignant Disease.** — The second class of cases of malignant disease of the lungs, in which the disease manifests itself in the form of isolated masses of larger size, is the most common. There may be one such tumour or several, at first assuming a rounded form, but as they gradually invade the lung, acquiring an indefinite shape, and involving a large portion or even the whole of the lung. Such tumours, being most frequently of the encephaloid varieties of malignant disease, often grow rapidly, and as rapidly disintegrate, giving rise to hæmorrhage and destruction, not only of the mass itself, but also of the surrounding tissues. In this way vomicæ may be formed, or portions of lung may become gangrenous. The symptoms and progress of these cases necessarily vary much. If the growth or growths have attained any considerable size, there is dulness on percussion, and an absence of respiratory murmur over the affected portion of lung. The presence and character of other physical signs depend very much on the patency or occlusion of the bronchi. When, as is often the case, these are completely occluded, nothing whatever may be detected on auscultation, and all vocal fremitus may be absent; the implicated portion being completely shut off from the rest of the lung, and from all communication with the trachea. If, however, the bronchi remain patent, or—as the result of breaking down of the cancerous mass—if communication with the larger bronchi has been re-established, we have evidence of abundant secretion, and the ordinary phenomena associated with a cavity. In such circumstances microscopic examination of the expectorated matters may give decisive evidence of the nature of the case. On the other hand, before any such consequences have arisen, we may have in the case of a large tumour involving the whole or the greater part of one lung auscultatory signs which are with difficulty distinguishable from those of extensive pleuritic effusion. In other instances, where the portion of lung implicated in the cancerous growth is limited and well-defined, the physical signs may so closely resemble those of phthisis as to lead astray the most expert. Thus we may have limited dulness on percussion, with absence of respiration; followed by signs of surrounding irritation, slight hæmoptysis, cough, expectoration, and indications of a cavity. In some rare instances there have been limited flattening and altered form of the chest-walls, such as characterise chronic phthisis. Copious hæmoptysis, except in connection with extensive destruction of lung-tissue, is not common in cancer

of the lung. The diagnosis in these instances, where the local signs so closely resemble phthisis, must be based mainly on the constitutional symptoms, and the history of the case. There is considerable difference as to the progress and mode of termination in the whole of the class of cases now under consideration. Long before the local changes have advanced far enough to admit of a decisive diagnosis, the patient may die from rapidly-increasing debility and emaciation, with more or less of hectic fever, and even typhoid phenomena; or he may be carried off by rapidly-occurring pleuritic effusion. In other instances cancer developing in other organs is the cause of death. Indeed, in a large proportion of cases the manifestation of malignant growths in the neck, the axilla, or other parts, places beyond question the nature of the case. So long as the growth is confined to the substance of the lung, and does not implicate the nerve-trunks and larger vessels, there is usually little pain, paroxysmal dyspnœa, or disturbance of the heart's action, excepting such as may be due to feebleness of muscular power. Nor is there generally any external œdema, or distension of the superficial veins. The reverse of all this characterises the cases in which the mediastinum and the roots of the lungs become involved.

3. Mediastinal Tumours.—This form of malignant disease of the lungs is described under a separate heading. *See* MEDIASTINUM, Diseases of.

PROGNOSIS AND TREATMENT.—The subject of the prognosis and treatment of malignant disease of the lungs in its various forms, will be more conveniently discussed in the article MEDIASTINUM, Diseases of.

J. RISDON BENNETT.

LUNGS, Malpositions of.—Among malpositions may be regarded those conditions in which the lung is contracted more or less within its normal limits; or, on the other hand, distended so as to pass beyond its usual boundaries. One or both organs may be thus affected. These alterations may result either from more or less diminution of the amount of air in the lungs, as in cases of compression or collapse; from excess of the same, as in emphysema and hypertrophy; or from diseases which affect their structure. The lung may also be displaced by the pressure of tumours, in addition to being compressed. The most important malposition of the lung, however, is that known as *hernia*, in which a portion of the organ projects into the neck, or through some part of the chest-walls, or through the diaphragm into the abdominal cavity. If the hernia passes towards the surface of the body, it may be made out clinically, being indicated by a soft and compressible swelling, localised, resonant on percussion, and rendered more prominent by a cough. Pulmonary symptoms might possibly be present. It is impracticable to detect a hernia of the lungs through the diaphragm. FREDERICK T. ROBERTS.

LUNGS, Morbid Growths in.—The formations in the lungs which belong to the class of morbid growths may be thus enumerated, in the order of their importance:—1. *Tubercle.* 2. *Cancer.* 3. *Syphilitic gummata.* 4. *Hydatids.* 5. *Rare formations*, such as sarcoma, enchondroma, osteoid and myeloid growths, hæmatoma, lymphatic formations, &c. Most of these are discussed under their appropriate headings, and it is unnecessary to allude to them any further here. Those belonging to the last group are usually rather of pathological interest than of clinical importance, as they rarely give rise to any local symptoms or physical signs during life, and are merely discovered, as a rule, at the *post-mortem* examination. It is a question how far some of these growths are to be regarded as being of a malignant nature. In some cases they are secondary to similar growths elsewhere, or the lung may be involved by extension. Lymphatic formations in the lungs are sometimes observed in cases of Hodgkin's disease.

EFFECTS.—It may be useful to indicate the effects, if any, which morbid growths may produce in connection with the lungs. 1. The lung-tissues may merely be more or less displaced and compressed; or, in course of time, become absorbed or atrophied, in proportion as the growth progresses. 2. The distribution of air in the lungs may be modified by the mere presence of a growth, so that in one part it is in excess, and in another part deficient. 3. Similarly, the circulation of blood may be disturbed, leading to congestion in one part, and anæmia in another. 4. Morbid formations are very liable to cause local irritation. Hence they may induce bronchial congestion and catarrh, localised acute pneumonia and its consequences, or chronic interstitial pneumonia, which may lead to the formation of a fibrous capsule around a growth. 5. Certain formations are liable to undergo degenerative and destructive processes, either in themselves, or along with the pulmonary tissues. In this way they originate ulcerations or cavities, and may give rise to products, which are not only injurious to the lungs, but also infect distant parts to which they may be conveyed. After destruction reparative processes not unfrequently take place, with loss, however, of the involved portions of the lung-structures. It must be remarked here that some morbid growths seem to become infiltrated through the pulmonary tissues without destroying them; and under appropriate treatment the growth is absorbed, leaving the involved portion of the lung intact. This applies, for instance, to some cases of syphilitic infiltration. 6. Growths in the lungs sometimes extend beyond these organs, so as to interfere with neighbouring structures, causing irritation, pressure, or destructive effects. Thus, local pleurisy, pressure on vessels or nerves, destruction of bones, and other consequences may ensue. In short, the growths become then practically intra-thoracic tumours, and produce similar effects.

SYMPTOMS.—What has been stated as to the effects of morbid growths in the lungs will readily explain the clinical signs which they tend to originate. They may be of such little consequence that they produce no sign whatever during life, not interfering in any way with the respiratory functions, or being themselves in insufficient amount to be discoverable by physical examination. Indeed, some formations may invade the lungs to a considerable extent so insidiously that no evident symptoms are induced.

The writer has known cases in which the lungs were extensively implicated in secondary cancer without any symptoms, except some feeling of shortness of breath on exertion. Usually, however, various degrees and combinations of the ordinary pulmonary symptoms may be anticipated—namely, pain in some part of the chest, cough, expectoration, the sputum sometimes containing fragments of the growth, hæmoptysis, and dyspnœa. Pressure-symptoms in connection with other structures are induced in some cases. Physical examination may detect the disease when there are no symptoms; or these may coexist with physical signs, which either reveal the presence of the morbid formation itself—such as alteration in the shape and size of the chest, deficient expansion, dulness, bronchial or other abnormal breath-sounds, modified vocal fremitus and resonance; of its effects on the lungs; of the formation of cavities; or of its effects on neighbouring parts. The particulars relating to these points are discussed in other articles. Definite general symptoms are associated with many forms of morbid growth in the lungs.

Treatment.—The principles of treatment of morbid growths in the lungs are, first, to get rid of them, if possible, by medicinal means, as in the case of syphilis; secondly, to treat their effects; thirdly, to treat local symptoms which may arise; and fourthly, to treat the general symptoms. Frederick T. Roberts.

LUNGS, Œdema of.—Synon.: Fr. *Œdème du Poumon*; Ger. *Lungenödem.*

Definition.—Infiltration of the pulmonary tissue with serous fluid.

The serous fluid is effused from the pulmonary capillaries into the pulmonary textures, and into the alveolar and bronchial spaces.

Ætiology.— The causes of this exudation are manifold, but of two sorts:—(*a*) *Disordered circulation:*—1. active congestion, attendant upon inflammatory conditions of the lungs and bronchi; 2. passive congestion; 3. mechanical congestion—in heart-diseases, emphysema, or pressure upon the pulmonary veins; 4. want of tone of vessels after inflammatory conditions, as pneumonia or bronchitis, or pressure upon the vagus nerve or pulmonary plexus; 5. afflux of blood to the lungs in croup, and during the asthmatic paroxysms determined by the ineffectual efforts at inspiration. (*b*) *Morbid conditions of the blood*:—in albuminuria, and to a less degree in other diseases in which the condition of the blood is altered or impaired—for example, scurvy, purpura, anæmia, hydræmia—the lungs partaking of the general disposition to dropsy.

Anatomical Characters.—In cases of œdema pulmonum, the lungs are usually large, filling the thoracic cavity, and sometimes indented by the ribs. They are heavy; their pleural surfaces are wet; and the pleural cavities contain an excess of serum. Both lungs are as a rule affected, their lower and most dependent portions chiefly; and one lung, on the side to which the patient has last inclined, is more highly œdematous than the other. The higher the degree of œdema, the less crepitant the lung, and the more distinctly the surface pits on pressure. A portion cut from a simply œdematous lung will, however, almost always float in water; but at the base of the lung there is usually some collapse in addition to the œdema, and a portion removed therefrom sinks. On section the lung exudes abundant thin serum, and more or less frothy fluid, with which the bronchial tubes are also occupied. On first making a section, the succulent tissue will break down easily under the finger; but, after the excess of fluid has been squeezed out, the lung feels toughened. Œdema may be found at any portion of the lung—at the apex, for instance, determined there by the inflammatory process. The transition between œdema and inflammatory consolidation is very gradual. Œdema is also very apt to pass into, or to be complicated with, a certain degree of inflammation. The degree of friability, and of compressibility, and the application of the water test, are the readiest methods of distinguishing between the two. If a portion of œdematous lung be examined under the microscope, the alveoli are found to contain more or less numerous large granular cells, but these are never so numerous as to occupy entirely the alveoli.

Symptoms.—The symptoms of œdema of the lungs are—in addition to those of the disease which has produced it—dyspnœa, which may amount to orthopnœa; troublesome 'retching' cough; and difficult, yet tolerably abundant, frothy, serous expectoration. The percussion-note is deadened at both bases, although the dulness is usually more extensive at one base than the other; the vocal fremitus is diminished; the respiratory murmur is enfeebled or lost; and a fine bubbling crepitation is heard.

Diagnosis.—The diagnosis of pulmonary œdema is not usually difficult. The absence of pleuritic pains and of fever, and the double-sidedness of the disease, together with the absence of any true bronchial breathing or ægophony, will exclude pneumonia or pleurisy. The presence of dulness will also distinguish the condition from simple capillary bronchitis, with a certain degree of which, however, it is often combined. The general condition of the patient, and the presence or absence of those diseases or circumstances which are known to produce œdema of the lungs, must be carefully taken into consideration. If, for instance, after an asthmatic paroxysm we hear some fine bubbling *râles* over the bases of the lungs, and find the patient expectorating an unusual quantity of frothy serous fluid, we may suspect pulmonary œdema rather than bronchitis.

Prognosis.—The prognosis in œdema of the lungs depends mainly upon the general or local conditions with which it is associated. It is of very grave purport in chronic Bright's disease, or in heart-disease. It is also a grave complication in chronic bronchitis, showing failure of heart-power. It is, however, often a transient and unimportant affection when it succeeds to acute chest-affections, as pneumonia or bronchitis, or to asthma. As a complication of acute chest-affections, it is rarely recognised clinically.

Treatment.—The treatment of pulmonary œdema is, in all important cases, derivative. Poultices are to be applied to the chest, with

sufficient mustard to produce redness. Dry-cupping will often give great relief. Blisters should be avoided. Watery purgatives should be administered, according to the strength of the patient. Diuretics are useful in some cases, especially the vegetable diuretics, such as digitalis, juniper, and scoparium, as also nitric ether; and the same is to be said of diaphoretics, for example, acetate of ammonia, warmth, air baths. Moderate stimulation and support must be kept up. Kidney or heart-disease if present will mainly determine the exact treatment. If there be failure of cardiac power, æther, ammonia, and alcoholic stimulants are required; and if the heart's action continues hurried or irregular, digitalis is especially indicated. When we suspect a loss of tone of vessels, as after bronchitis or pneumonia and in anæmic states, perchloride of iron with some mineral acid is to be recommended.

In all cases rest in bed or on a couch is necessary. R. DOUGLAS POWELL.

LUNG, Perforation of.—SYNON.: The term *pneumothorax* is almost equivalent.

DEFINITION.—The formation of an opening through the pulmonary pleura, communicating with the interior of the lung.

ÆTIOLOGY.—Perforation of the lung may arise in many ways. Its causes may be classified under the three following headings:—

1. *Penetrating wounds*; for example, gunshot wound, punctured wound, or laceration by a broken rib.

2. *Diseases affecting the pleural cavity or neighbouring organs*; such as empyema, hepatic abscess or hydatid, or suppuration of the bronchial glands.

3. *Disease affecting the lung itself*; for instance, phthisis, emphysema, gangrene, hydatids, or cancer.

Of all the causes of perforation of the lung, phthisis is infinitely the most common. It is the rule in phthisis for pleuritic adhesions to form *pari passu* with the pulmonary lesion, and these adhesions are usually very firm and difficult to break down. In neither respect, however, does this rule always hold good. In some rare cases in the earliest stage of the disease a small tubercular nodule situated immediately under the pleura softens, and the pleura gives way. Again, at any stage of the disease an outlying tubercular mass, situated below the point to which the pleural adhesions have extended, may soften and rupture into the pleural cavity.

In the more acute pneumonic varieties of phthisis there is often a singular indisposition to the formation of pleural adhesions. The pulmonary pleura in such cases becomes covered with a thin, smooth, translucent layer of lymph, shining through which can be seen at several points opaque yellow spots. These spots are found to correspond with underlying masses of softened cheesy material, by which the pleura has been undermined and deprived of its vascular supply. Pneumothorax has its most frequent origin in rupture of the pleura at one of these yellow points.

Finally, sinuses are sometimes found leading from old cavities within the lung to the pleural surface. Occasionally these sinuses, the pleura being adherent, penetrate through the thoracic wall and point externally. In other cases, of which the writer has seen two examples, they may open into the opposite pleural cavity.

ANATOMICAL CHARACTERS.—The affected lung is in all cases collapsed, and in cases of old standing may be so completely so, and covered by such thick layers of lymph, as to be found only with difficulty. The opening may have closed. It is sometimes difficult to discern. It may consist of a small slit, communicating with a cavity by a slanting sinus, so as to form a complete valve; or it may be of considerable size, and communicate widely with a cavity or bronchus. All degrees of patency between these two extremes occur. The position of the opening is very variable; it is most commonly situated somewhere on the lateral or convex side of the lung. The rupture is almost always into the pleural cavity on the same side. It may, however, take place into the opposite pleural cavity, through the mediastinal fold of pleura. The pleura is inflamed, and covered with lymph; and its cavity contains air, and a greater or less quantity of purulent fluid. The heart is displaced, unless in some rare case it be held by a strong adhesion. Some years ago the writer tested the degree of air-pressure present in ten cases of pneumothorax by means of a water-pressure gauge. In two cases it was *nil*; in one case it was equal to 1·25 inch; in two cases 2 inches; in one case 3·75 inches; in two cases 4 inches; in one case 5·3 inches; and in a double case it equalled 3·5 inches in one pleura, and 2·7 in the other. The gas effused approximates in composition to that of expired air, containing from 8 to 16 per cent. of carbonic acid. Sometimes sulphuretted hydrogen also is found in fœtid cases.

SYMPTOMS AND SIGNS.—The symptoms and signs of perforation of the pleura are those of pneumothorax and of hydro-pneumothorax. At the moment of attack sudden acute pain is felt in the chest, at the seat of rupture, and is immediately followed by great dyspnœa and shock. In a well-marked case the expression of face is peculiarly agonized and terror-stricken; the extremities are cold; damp sweats break out; the pulse is quick and small; and the respirations are exceedingly rapid. The position of the patient is that of orthopnœa, with an inclination forwards, and to the sound side; it is, however, frequently changed in the endeavour to gain breath. The voice is feeble and whispering. The urgency of the shock and dyspnœa depends upon the amount of useful lung suddenly disabled. If the patient survive the attack, after two or three days fever of a hectic character, with sweats, supervenes. In some cases, however, the symptoms of pneumothorax come on very insidiously.

Physical signs.—The physical signs are very characteristic. There is enlargement of the side affected, and effacement or bulging of the intercostal spaces. The heart is displaced towards the sound side. The percussion-note is hyper-resonant or tympanitic over the side affected, except where (at the apex) the lung may perhaps be still adherent; and on auscultation either no respiration at all is audible, or amphoric breathing of a peculiar character may be heard

at one or more points, sometimes accompanied with the characteristic metallic tinkle. A peculiar metallic echo is heard if the patient coughs. If, whilst the ear is applied, a coin placed on the diseased side is struck with another coin, a characteristic bell-note is heard. The vocal fremitus is diminished or lost. At a later stage, when more or less effusion has taken place, the signs of hydro-pneumothorax present themselves, namely, dulness below and hyper-resonance above—in varying proportions and shifting in relative position with the posture of the patient. If the amount of fluid be moderate, a splash or succussion-sound may be elicited. This sound may be audible to the ear applied to the chest, or to bystanders. If the fluid effusion be considerable, intercostal fluctuation may be felt; and this fluctuation gives to the finger, on percussion at the level of junction of air and fluid, a peculiar sensation of thrill. The position usually assumed by the patient now is with the head raised, and leaning towards the diseased side.

Diagnosis.—The diagnosis of perforation of the lung is to be made from other diseases; and also with respect to the probable nature of the opening, and the degree of pressure present. If the three essential signs of pneumothorax be remembered, namely, displacement of heart, tympanitic percussion-note, and either absence of respiration or amphoric breathing, there can scarcely be any difficulty in making the diagnosis. It cannot be confounded with a bilateral disease like emphysema. The shifting resonance and dulness, the succussion-splash, with perhaps metallic tinkle and amphoric breath-sound, are signs abundantly sufficient to distinguish hydro-pneumothorax from ordinary empyema. Respecting the nature of the opening —whether valvular or free, careful auscultation will usually gain the desired information. If amphoric breathing be well-marked, it may be assumed that the opening is a free and tolerably direct one; if, on the other hand, no respiratory sound be audible, the communication with the pleura is indirect and more or less completely valvular. In the latter case the pressure-symptoms become more urgent.

Prognosis.—Of course the prognosis in every case of tubercular pneumothorax is necessarily very grave, but by no means equally grave in all cases. The following considerations will guide to a correct prognosis. (*a*) *Nature of opening.* If the communication with the pleura be valvular, signified by the entire absence of breath-sound, and the increasing urgency of dyspnœa, the patient will die in a few hours, unless relieved by paracentesis. (*b*) *State of the opposite lung.* If the effusion of air have occurred on the side least affected by previous disease, the case is correspondingly hopeless. If, on the other hand, we know that the lung now collapsed was previously much diseased, and if the other lung be but little affected, the duration of life may not be greatly shortened by the accident. Life is then gradually extinguished by hectic fever, and progressive disease in the opposite lung. It is by no means impossible, and probably happens more frequently than is supposed, that the opening in the pleura may close, the air become absorbed, and the case converted into one of simple empyema. In pneumothorax arising from accidental wound or injury to the lung, the prognosis depends upon the visceral injury. The air in the pleura is absorbed with considerable readiness.

Treatment.—In all cases in which death is threatened by asphyxia, in consequence of air accumulating in the pleura, paracentesis with a fine trochar must be performed. This will in such cases give great relief, and may be repeated if necessary. There is a tendency for an opening at first completely valvular to become at a later period more patent or possibly to close, so that it is better to operate when necessary with a fine trochar than to make a permanent opening. Rest to the affected side should be secured, as far as possible, by the application of a broad piece of strapping extending round the side to beyond the middle line in front and behind. The shock and dyspnœa are best treated by opium in repeated small doses. Stimulants may also be necessary, but opium is far more useful.

R. Douglas Powell.

LUNG, Rupture of.—Rupture of the lung is an extremely rare occurrence. Cases of so-called rupture of the lung from external violence are, for the most part, really produced by perforation or laceration of the pleura by a fractured rib. It is said that rupture of the lung may occur in whooping-cough.

LUNGS, Syphilitic Disease of.—There is still much uncertainty as to the effects which syphilis may produce in connection with the lungs, but there can be no doubt that it does sometimes originate specific lesions in these organs, though much less frequently than in most of the other viscera. They are generally only met with in advanced cases of acquired syphilis, when the signs of the disease are markedly developed in other parts. Occasionally the lungs are involved in congenital syphilis. The presence of a tubercular or scrofulous diathesis has been supposed to predispose to the implication of the lungs in syphilitic disease.

Anatomical Characters.—Gummata constitute the most certain and unquestionable lesions of a syphilitic nature in the lungs, but they are rare. When present, they vary in number from one to many. In the latter case they are disseminated, but are stated to have a predilection for the deeper parts of the organs. In size these growths usually vary from a pea to a walnut, but may reach the dimensions of a large egg. They are generally well-defined, rounded in shape, and often surrounded with a fibrous capsule. In their early condition gummata in the lungs appear on section greyish or brownish-red, homogeneous, firm, and dryish in consistence. Subsequently they tend to degenerate, becoming more or less caseous, yellow, and less consistent; and they may even break down in the centre, so as to form cavities. The structure of these gummata is found on microscopical examination to be made up of imperfect fibres, abortive nuclei, and a few fibre-cells, infiltrating the pulmonary tissues, and thickening the alveoli. Afterwards these are mixed with granular matter and other products of degeneration and disintegration.

There has been much discussion regarding the

relation of syphilis to another form of lesion affecting the lung-tissues, namely, a variety of chronic interstitial pneumonia. There seems every reason to believe that this morbid condition is in some instances due to syphilis. The result is a fibroid infiltration of the pulmonary tissue, which in its general and microscopic characters cannot be distinguished from a similar condition due to interstitial pneumonia from other causes, but the new tissue is said to be more vascular in its early stages. The affected parts are much indurated; and any bronchi which are implicated tend to become more or less dilated. The morbid condition may be distributed in various parts of the lungs, but appears to have a preference for their bases and the vicinity of their roots. It frequently originates at the surface, and penetrates thence into the interior of the lungs in the form of fibrous bands, the pleura being generally thickened or adherent, and superficial puckerings and depressions being visible. In other instances the new growth commences around gummata; or from a chronic contracting peri-bronchitis, associated with ulcerative inflammation (Pye-Smith). Dr. Green states that it originates mainly around the small interlobular blood-vessels. Syphilitic fibroid infiltration has no tendency to caseation; but it may become the seat of ulceration or gangrene.

In connection with congenital syphilis, a peculiar condition has been described as affecting the lungs in new-born or very young infants, under various names, such as syphilitic pneumonia, white hepatization, and epithelioma of the lungs. It assumes a more or less diffuse or infiltrated arrangement, but is of variable extent, and may involve one or both organs. One lung may be affected throughout, while the other is quite free from disease. The more obvious characters are as follows:—The pleura is usually unaffected. The lung is enlarged, and may be in a state of full expansion, so that its surface is marked by the ribs; it feels remarkably heavy; and at the seat of the disease is dense, firm, hard, and usually resistant, not breaking down under pressure. On section it presents a white or yellowish-white colour, being more or less bloodless; is uniform and smooth; and little or no fluid can be expressed or scraped from the cut surface. Careful examination reveals minute bands of fibrous tissue running in all directions. Microscopically the change seems to consist mainly in thickening of the alveolar walls and minute bronchi, due to an imperfectly fibrillated and nucleated tissue, which undergoes degenerative changes. Most observers further describe an increase in the epithelial cells, which fill the air-vesicles and minute air-tubes, but Wagner denies this. The vessels also become thickened and ultimately obliterated.

It may be remarked that the bronchial tubes or their divisions may be affected with syphilitic disease, their submucuous tissue, or occasionally their deeper structures, becoming infiltrated with a fibro-nuclear growth. Ulceration may take place, followed by cicatrization, and leading to thickening of their walls, and narrowing or even complete closure of their channel.

Symptoms.—In the present state of knowledge it is impossible to write with anything like definiteness respecting the clinical history of syphilitic disease of the lungs. As a matter of fact, in the majority of cases the lesions have only been discovered after death, no symptoms having occurred during life pointing to the lungs; or, these having been obscured by symptoms affecting other parts. In a case of recognised constitutional syphilis, attention should be paid to the lungs as well as to other organs, and it would be advisable to examine them from time to time, as physical signs might occur without any obvious symptoms to attract the patient's attention. If pulmonary symptoms should arise in a person undoubtedly syphilitic, or who had had syphilis, the possibility of the lungs being affected should specially be borne in mind. Among these symptoms hæmoptysis at an early period is said to be important. Physical examination might possibly reveal the presence of gummata, as evidenced by localised dulness, bronchial breathing, increased vocal fremitus and resonance, and other signs of consolidation. The most significant signs, however, are those indicating marked induration of the lung from fibroid infiltration, especially if unilateral, and confined to the base or middle portion of the organ. In course of time signs of cavities might become evident, due to breaking-down of gummata, or to dilated bronchi. The general symptoms are those of constitutional syphilis, combined with those of phthisis. There is but little or no pyrexis accompanying the pulmonary lesions; and the progress of the case is essentially chronic. The effects of treatment may be of peculiar significance in the diagnosis of syphilitic disease of the lungs. If such symptoms and physical signs connected with these organs as have been indicated above should disappear under the use of anti-syphilitic remedies, a diagnosis of this disease might fairly be made. Indeed some observers think that they frequently discover and cure it, but this is somewhat doubtful.

Treatment.—If syphilitic disease of the lungs be recognised or suspected, the appropriate treatment in most cases is to administer iodide of potassium freely and continuously. In some cases a mercurial course of treatment answers best; or perchloride of mercury might be combined with the iodide. It may be necessary to employ internal remedies or local applications for the relief of pulmonary symptoms. Cod-liver oil and tonics may be given with advantage for the amelioration of the general condition, in cases where such medicines are needed.

Frederick T. Roberts.

LUNGS, Tuberculosis of.—Tubercle is the most important morbid growth affecting the lung, but it is by no means a settled point what should be included under this term. Many pathologists only recognise as tubercle the so-called grey granulations; others regard the various masses and infiltrations noticed in cases of phthisis as of this nature, and they look upon tubercle in these organs as divisible into grey and yellow varieties, and arranged either in granules or as an infiltration. It is unnecessary in this place to discuss this subject further, as it is considered fully in other appropriate articles. *See* Phthisis; and Tuberculosis. Frederick T. Roberts.

LUPUS ERYTHEMATOSUS (*lupus*, a wolf, or a rodent disease; and *erythematosus*, related to erythema).—Synon.: *Seborrhœa congestiva.*

Definition.—A chronic hyperæmia of the skin, attended by a new cell-growth, followed by interstitial absorption, and ending in scar.

Ætiology.—Women are more liable to lupus erythematosus than men, in the proportion of 8 or 10 to 1. It is rare before puberty, and most often begins between the ages of 20 and 30 years; but no age of adult life up to 60 or 70 is exempt. Weakly persons are thought by some to be most liable, but it may attack perfectly healthy people—at any rate there is no intimate connection with any other special disease. This affection is not hereditary. It attacks all classes of society.

Anatomical Characters.—The capillaries of the cutis are dilated, and a small-celled new-growth develops in it, close under the epidermis, around the orifices of the sebaceous and hair-follicles and the sweat-ducts. There is an increased secretion of sebum; and crusts of epidermis and fatty matter form. The terminal scar is due to destruction of normal tissue by the new-growth; partial fatty degeneration and absorption of the latter; and conversion of the remainder into permanent connective-tissue.

Symptoms.—Lupus erythematosus most often attacks the face. Small patches of well-defined crimson or purplish redness form on the skin of the cheeks or nose, and remain for a long period unaltered; they then become covered in parts with thin, firmly adherent, dirty-looking crusts, which if removed are found to send processes into the dilated mouths of the sebaceous glands. In the final stage, the redness gives place to a very superficial whitish scar. Confluence of several small patches gives rise to irregular patterns. When both cheeks are attacked at once, the patches tend to unite across the nose in the shape of a bat's wing or butterfly. The scalp often suffers, and there is permanent loss of hair. Other seats of lupus erythematosus are the ears, eyelids, lips, and backs of the hands; but it may exceptionally occur on the arms and legs, on the trunk, and on several parts at one time. There is no pain, or ulceration, but sometimes slight itching. Exposure to cold winds or to great heat aggravates the disease. In Germany an acute form has been observed, in which the eruption quickly covers a large part of the body; is attended with fever and prostration; and may end in death. The writer has seen such a case.

Complications. — Recurrent erysipelas has been noticed more often in lupus erythematosus than in lupus vulgaris. These two forms of lupus may occur in the same individual.

Diagnosis.—This disease is to be diagnosed from lupus vulgaris, by its commencement after puberty; by its very superficial character; and by the sebaceous crusts. From eczema, which it sometimes resembles at first sight, lupus erythematosus may be distinguished by the history, chronicity, trifling itching, and the presence of scars. For its diagnosis from acne rosacea *see* Acne.

Prognosis.—This disease is very chronic, and may last for years. Permanent cure is very doubtful, on account of the tendency to relapse.

Except in the acute form, which is rare, there is no danger to life.

Treatment. — In the treatment of lupus erythematosus the first indication is to rectify any derangement of the general health. There is no specific internal remedy. Arsenic and mercury are not indicated; milk and cod-liver oil improve the nutrition. Externally, mild caustics suit best. Emplastrum hydrargyri should always be tried, spread thickly on linen, with enough oleum terebinthinæ to make it soft, and applied every night for a long period. The liniment or tincture of iodine can be painted on until slight inflammation is set up, and repeated after an interval; or spirit of soap (℞ saponis mollis ℥j, spiritûs vini ℥ss–℥j) may be rubbed in in the same way, and let dry on. Stronger caustics, such as the solution of caustic potash, *require great caution in their use* (*see* Lupus Vulgaris). Some cases do best with soothing remedies—such as unguentum zinci benzoati, or a lead lotion (℞ liquoris plumbi subacetatis ℥j, glycerini, ℥ij) applied warm after the crusts are removed; and the latter are always of service in the intervals between the caustics.

Edward I. Sparks.

LUPUS VULGARIS (*lupus*, a wolf, or a rodent disease; and *vulgaris*, common).—Synon.: Fr. *Scrofulide maligne*; *Dartre rongeante*; Ger. *Lupus*; *Fressende Flechte.*

Definition.—A very chronic non-contagious disease of the skin and mucous membranes; chiefly due to an infiltration of small round cells into their substance; attended either with epidermic exfoliation, interstitial absorption, or destructive ulceration.

Ætiology.—The ætiology of lupus vulgaris is unknown. Some cases occur in scrofulous persons with enlarged or suppurating lymphatic glands, diseases of the bones and joints, &c., or in the children of consumptive parents; but in the larger number lupus affects perfectly healthy people. Most cases begin very early in life, from the second or third year up to puberty. The ulcerative form—*lupus exedens*—may begin still later, but it is very rare for it to do so after the thirtieth year. Women are somewhat more liable to lupus than men, and country people than townspeople. It is in no way due to syphilis, either hereditary or acquired; and instances in which two members of the same family are attacked are rare.

Anatomical Characters.—The cutis in lupus is infiltrated with vast numbers of small round cells of about 0·004 mm. in diameter, which encroach on and gradually destroy its proper tissues. The new-growth has a certain resemblance to granulation-tissue (Virchow). It is highly vascular, and contains new-formed capillary vessels. Nodules have been described, disseminated through the cutis, each consisting of one or more central multinuclear giant-cells, surrounded by bands of smaller cells which shade off into the granulation-tissue. These nodules exactly resemble grey tubercle (Friedländer). Some authorities regard these giant-cells as retrograde products, due to central fusion of the endothelial cells of sweat-ducts, blood-vessels, and lymphatics, with persistence of their nuclei (Lang). The epidermis covering the lupus-tissue is thick-

ened; the lower cells of the rete mucosum are fattily degenerated, and contain reddish pigment. Lupus-tissue is very persistent. It may either undergo fatty degeneration and subsequent absorption, without lesion of the epidermis; or else the latter breaks down too, and ulceration is the result.

Symptoms.—Lupus usually begins as one or more small, smooth, reddish-brown, or reddish-yellow blotches, from the size of a pin's head to a split pea, which may be level with the skin, or else raised in the form of small tubercles. Several of these are generally aggregated into a patch, and a number of them may coalesce, so as to cover extensive surfaces of skin; but this is the exception rather than the rule. Any change that occurs is always slow, and a patch the size of a shilling or a florin may take years to form. In the non-ulcerative variety, thin, epidermic scales are continually thrown off from the surface of the tubercles—*lupus exfoliativus*. After a while, interstitial absorption of the lupus-cells begins in the older tubercles, and a bluish-white papery scar is left. In other cases the tubercles soften, ulcerate, and become covered with greenish-yellow adherent scabs, beneath which the ulcer extends. The surrounding parts are swollen, and the edge of the ulcer is pinkish. Removal of the scab exposes a loss of substance, with sharp-cut edges, and a granulating base covered with purulent secretion. The ulceration may attack structures deeper than the skin, and destroy cartilage, fibrous tissues, muscle, and even bone. The mucous membranes are not often primarily affected by lupus, though it often extends to them from the skin; instances are, however, recorded in which the larynx has been attacked, causing ulceration, partial destruction of the epiglottis, and warty outgrowths on the posterior wall.

Lupus may occur on any part of the body or limbs, but it has a special preference for the skin of the face. The non-ulcerative form chiefly selects the cheeks, and afterwards, in order of frequency, the nose, ears, legs, arms, and trunk. The ulcerative form — *lupus exedens* — begins almost exclusively on the nose, attacking chiefly its anterior portion, either the tip or the edges of the alæ. Sometimes it begins within the nostril. Unless proper treatment is at hand the nose may be entirely destroyed, and severe inroads made into the tissues of the cheeks, lips, and other neighbouring parts.

Complications and Sequelæ.—Lupus may co-exist with enlarged and suppurating glands in the neck and elsewhere; with various scrofulous affections; with phthisis; and with chronic Bright's disease. Great deformity may result from the contraction of the scars which it leaves, for example, ectropion, stricture of the nares, and distortion of the mouth. About a dozen cases have been recorded in which epithelioma developed on a patch of lupus of many years' standing, or on a lupus scar. We may regard such cases as arising from the stimulus of the proliferative processes in the cutis on the neighbouring epithelium.

Diagnosis.—The duration and position of lupus vulgaris, and the absence of thick scaliness and itching, will generally render it easy to distinguish this disease from circumscribed forms of psoriasis and eczema; and its commencement in early life will clearly separate it from epithelial cancer and rodent ulcer. It is with syphilis that it is most apt to be confounded, and the diagnosis between lupus exedens on the nose, and an ulcerating syphilide, is sometimes extremely difficult, or at first sight impossible. In these cases, after carefully considering the history, we must examine other parts of the body for traces of syphilis, and an inspection of the mouth and pharynx will often materially assist us; and lastly, the greater chronicity and slower extension of lupus, as well as its resistance to specific treatment, will generally lead to a correct opinion. Indolence is a character of special value in deciding between lupus and syphilis, particularly as affecting the mucous membranes. Syphilis has also more tendency to suppuration than lupus.

Prognosis.—Lupus is never fatal *per se*, but it can never be looked on in a favourable light, owing to its tendency to relapse under treatment, and its invariable termination in a contracting cicatrix.

Treatment—*Internal*.—Internal treatment is only of use in lupus vulgaris where the patient's general health is bad, or where well-marked symptoms of scrofula are present. In these cases great benefit may be derived from tonics, especially the iodide of iron, and from cod-liver oil in as large doses as can be tolerated. Nutritious food should be freely given; and the patient should take plenty of outdoor exercise in a bracing climate.

External.—The real cure for all forms of lupus must always consist in the destruction of the new tissue forming it, by caustic agents of various strengths. A number of such remedies have been proposed, but the successful application of each seems often to depend more on individual experience of its use, than on the superiority of any one caustic over the rest. The caustics most generally used are caustic potash, nitrate of silver, and acid nitrate of mercury. Equal parts of caustic potash and distilled water may be applied with a tiny piece of sponge, so as to limit the action as much as possible. The pain which follows is not of long duration—a point of much importance where a caustic must be repeatedly used. Solid nitrate of silver should be bored freely into all ulcerated parts or soft tubercles. The lupus-tissue offers but slight resistance to it, whereas it will not penetrate or injure healthy parts. Acid nitrate of mercury may be painted on with a glass brush. The crusts which form after any of these agents, fall off in ten days or a fortnight, and it is not advisable to repeat the application at shorter intervals. As a rule no dressing except zinc ointment is required. Some authorities prefer the actual or else the galvanic cautery, but both these measures have the disadvantage of disfiguring the parts, so that it is difficult to determine when healthy tissues are reached. Others advise multiple scarification, with one or more fine-bladed knives, so as to obliterate blood-vessels, and produce absorption by starving the lupus tissue and exciting inflammation

(Volkmann, Veiel). For a more detailed description of the mechanical methods of treatment, including that by 'scraping,' *see* APPENDIX. In the treatment of the superficial patches of lupus non-exedens, the repeated application of mercurial plaster during several months has sometimes been followed by absorption of the growth. Pyrogallic acid ointment (1 to 10) has been used by Hebra and others with much success. In other cases painting with tincture or liniment of iodine, and coating with gutta-percha foil, produces slow improvement; and where no ulceration exists, demanding active interference, these milder remedies deserve a trial. *See* APPENDIX. EDWARD I. SPARKS.

LYMPH (*νύμφη*, a nymph, water).—Physiologically, lymph signifies the fluid which circulates in the lymphatic system. Pathologically, the term is applied to the coagulable exudation which escapes from the vessels in inflammation. The name 'vaccine lymph,' or 'lymph,' is also given to the fluid contained in the vaccine-vesicle. *See* INFLAMMATION; and VACCINIA.

LYMPHADENITIS (*lympha*, lymph, and *adenitis*, inflammation of a gland).—Inflammation of lymphatic glands. *See* LYMPHATIC SYSTEM, Diseases of.

LYMPHADENOMA.—SYNON.: Hodgkin's Disease; *Anæmia Lymphatica* (Wilks); Fr. *Adénie* (Trousseau); *Lymphadénie* (Ranvier); Ger. *Pseudoleukämie* (Wunderlich).

DEFINITION.—A disease characterised by more or less widely-spread enlargement of the lymphatic glands, accompanied frequently by enlargement of the spleen, and by progressive anæmia.

HISTORY.—Cases of coincident enlargement of the lymphatic glands and spleen were noted by Malpighi (1669) and Morgagni (1752). The nature of the glandular change was first carefully described by Craigie, (1828); and the general clinical history of the affection was pointed out by Hodgkin (1832), and by Wilks (1856). The most important subsequent observations are those of Virchow (1864), Wilks (1865), Trousseau (1865), Wunderlich (1858 and 1866), and Murchison (1870).

NATURE.—The enlargement of the lymphatic glands, which consists at first of mere hyperplasia, and subsequently of fibroid induration, varies much in its extent. A few glands only may suffer, or every gland in the body may be enlarged. The former cases have the characters of a local growth; the latter is distinctly a general disease, for which the term *lymphadenosis* seems the most exact. The glands vary in consistence: when soft there may a considerable excess of leucocytes in the blood; when hard there may be simple anæmia. This difference does not afford sufficient ground for separation. The enlargement of the spleen is usually due to disseminated growths, arising in the Malpighian bodies: sometimes there is also hyperplasia of the splenic pulp, as in splenic leucocythæmia.

ÆTIOLOGY.— In two-thirds of the cases of lymphadenoma, no cause can be traced, and the ascertainable antecedents of the disease, in most of the remaining cases, evidently constitute only a small part of the influences to which it is due. Hereditary transmission has not been distinctly proved. The disease is three times as frequent in males as in females. It is met with at all ages, but is most frequent in early and late adult life. It occurs, but is not specially frequent, in children under ten years, and, having regard to the numbers living, it is least frequent between the ages of forty and fifty years. Intemperance, mental depression, insufficient food, and over-exertion have been noted, in rare cases, as antecedents. Exposure to cold, in several instances, has appeared to be the exciting cause of the affection. It is doubtful whether the disease has any relation to constitutional syphilis. In several cases the symptoms have first appeared after child-birth. Various febrile affections have, in a few instances, preceded the affection. The exciting cause which has been noted most frequently is some local irritation, as of a decayed tooth, discharge from the ear, sore-throat, inflammation of the lachrymal sac, or eczema. In these cases the glands nearest the source of irritation first enlarged, and then more distant ones became affected.

ANATOMICAL CHARACTERS.—The several groups of glands are affected in the following order of frequency, beginning with those most commonly diseased: cervical, axillary, inguinal, retro-peritoneal, bronchial, mediastinal, mesenteric. Subsidiary adjacent glands are often enlarged together with the chief groups, and nodular growths, similar to enlarged glands, arise in the course of the lymphatics in places in which the existence of glands is not usually recognised, so that continuous chains of nodules connect the various groups. The size attained by the glands in lymphadenoma varies from that of a bean to that of a hen's egg. At first the individual glands are separate and movable one on another. Ultimately they often unite to form a conglomerate mass, in consequence, in most cases, of the perforation of the capsules of the glands by growth, which may also invade adjacent parts. The cervical glands are usually enlarged in both the anterior and posterior triangle; and the submaxillary glands may encircle the neck beneath the lower jaw. They may press on the trachea or larynx, displace the latter, compress the internal jugular vein, and cause paralysis of the recurrent laryngeal nerve. The occipital glands are usually also enlarged. The axillary glands often form a mass of very large size, and prolongations may extend beneath the pectoral muscle. The glands in the anterior mediastinum frequently suffer, and the growth may extend to adjacent structures, such as the pericardium, which may be perforated. The thymus may be involved, secondarily or primarily, or may escape. The bronchial glands are diseased more frequently than the cardiac glands, and the trachea and bronchi may be pressed upon, or the lung invaded. The retro-peritoneal glands often form a mass of large size, which may surround and compress the solar plexus, causing symptoms similar to those of Addison's disease. Enlargement of the mesenteric glands is neither common nor considerable. The inguinal group is frequently diseased, and the femoral vessels and crural nerves may be thereby compressed. The consistence of the enlarged glands may be either soft or very hard. Usually

the longer the enlargement has existed, the firmer are the glands. Their section is more uniform than in health. The colour is yellowish or whitish-grey. In the firmer glands dense tracts of fibrous tissue are seen to pass in different directions. Rarely the follicles have a different appearance, being opaque and yellowish from fatty degeneration, whilst the septa are white and conspicuous, from fibroid thickening. Caseation is, however, rare, and when it occurs is commonly confined to one or two glands. When caseation is general, the cases are of a form intermediate between lymphadenoma and scrofula. The softer glands yield a juice on scraping; the firmer glands yield no juice. In the former, the only histological change is an enormous increase in the cellular elements—the lymph-corpuscles of the reticulum; but the relations of the septa and follicles often remain normal. Sometimes the cell-growth invades the septa, which become split up and disappear; and it may even, in a similar manner, perforate the capsule. The firmer glands present much fibrous tissue, which may be confined to the septa, or invade also the delicate network in the substance of the gland; and then the cells gradually disappear, and the whole substance of the gland may be transformed into a fibrous mass. The tracts of fibrous tissue may have under the microscope a peculiar vitreous aspect, especially around the arteries.

The spleen is diseased in at least four-fifths of the cases, usually in consequence of disseminated growths, often irregular in shape, arising from the Malpighian corpuscles, yellowish or greyish white, rarely caseating, and usually corresponding in consistence, and resembling in structure, the glands in the same case. The splenic pulp may be normal in quantity, or may be compressed and atrophied. In some cases it is also increased in quantity, and this increase may even be the sole change. In such cases the morbid changes of lymphadenoma and splenic leucocythæmia coexist, and there is often a much greater increase in the white corpuscles of the blood, than when the spleen is the seat of simple growths. The size attained, in the cases of nodular growths, is not great, the weight being from ten to thirty ounces. When the splenic pulp is increased, the size attained is rather greater. In the latter case the enlargement is uniform, while it may be irregular when there are growths. The medulla of bones has been found, in rare cases, to present a change similar to that met with in splenic leucocythæmia and pernicious anæmia. Collections of adenoid tissue elsewhere often undergo changes similar to that of the lymphatic glands. The tonsils, the mucous membrane of the pharynx, the œsophagus, the stomach, and the large and small intestines, may all be the seat of growths, originating in the follicular glands, and sometimes ulcerating. The liver is often the seat of scattered lymphoid growths, usually minute, varying in size from a small pea to a pin's-head. They occupy the interlobular spaces. Rarely larger nodular growths are found. In other cases the liver is simply congested. Similar minute growths are often found in the kidneys, chiefly in the cortex; and these organs may also be the seat of parenchymatous degeneration. The peritoneum may be inflamed over enlarged glands, or may be the seat of growths. Growths have also been found in the testicles; and frequently in the lungs, where they may break down and form cavities.

Symptoms.—The most important symptoms of lymphadenoma are due to the altered blood-state, and to the enlarged glands. The latter cause the earliest symptoms, and the cervical glands are commonly the first to enlarge. When the internal glands are primarily affected, pain and pressure-signs may precede other symptoms. Occasionally the signs of anæmia precede those of the local change; and, in rare instances, irregular febrile disturbance may occur before the glandular enlargement. The affected glands are smooth, and present, at first, a peculiar mobility, which may disappear when they become adherent, and constitute an irregular lobular tumour of some size. They are usually painless, except during periods of rapid growth. A diminution in size has been observed before death. The enlargement of the cervical glands may cause the neck to equal, or even exceed, the head in circumference. The pressure on the veins may cause symptoms of passive cerebral congestion. The larynx may be displaced; and the movements of the lower jaw may be interfered with. Pressure on the trachea, by the glands in the neck and in the posterior mediastinum, may cause dyspnœa and even death by suffocation. That on the pharynx and œsophagus may obstruct deglutition, and cause death by starvation. The enlargement of the axillary and inguinal glands may interfere with the movement of the limbs, and impede the circulation. Various and serious pressure-effects result from the enlargement of the thoracic and abdominal glands, obstruction in veins, pressure on nerves, &c. The enlargement of the spleen can usually readily be felt, but does not commonly give rise to symptoms. Anæmia is one of the conspicuous symptoms, and may precede, or succeed, obtrusive affection of the glands. The red corpuscles may be reduced to fifty, thirty, and even twenty-five per cent. of the normal. In most cases there is no marked excess of white corpuscles, but occasionally they are much more numerous than normal. In almost all cases in which their excess is comparable to that met with in splenic leucocythæmia, the splenic pulp is increased in quantity, and the lesions of splenic leucocythæmia and of lymphadenoma are conjoined. The liver may be enlarged from the disseminated growths, and from congestion. Jaundice only occurs from the pressure of enlarged portal glands upon the bile-ducts. Ascites may be due to similar pressure, or to the blood-state, being then part of general dropsy. The function of the kidneys is rarely affected. Stomatitis, sometimes ulcerating, results from the lymphoid growth in the mucous membrane; and a similar change in the stomach causes interference with digestion and vomiting—symptoms which are increased by the anæmia. Slight dyspnœa results from the blood-state, while intense difficulty of breathing, and even actual suffocation, may occur from the pressure of enlarged glands on the trachea or bronchi. The functions of the

nervous system are variously deranged by the ill-nourished blood. Towards the end there may be convulsions, delirium, and coma. Pyrexia is a frequent, but not invariable symptom. It is almost always present in early life, much less common at advanced ages. The temperature may be considerably raised, even when the glandular enlargement is slight; the elevation varies from two to six degrees, and may be continuous, or with daily remissions, or periods of considerable elevation may alternate with periods in which it is only slightly raised.

Complications.—The pressure-effects of the enlarged glands, already mentioned, are sometimes so considerable as to give rise to complications, as thrombosis in vessels, pleural and pericardial effusions, and bronzing of the skin from disease of the solar plexus. Intercurrent affections, occasionally met with, are Bright's disease, pneumonia, fatty degeneration of the heart and liver, erysipelas, pemphigus, boils, and other effects.

Course and Duration.—The disease may remain local for a long time, even years, affecting one group of glands only, and subsequently slowly becoming general. When the general enlargement of glands is established, the disease rarely lasts more than two years. It usually terminates fatally by asthenia; but not rarely by some secondary effect of the morbid process, as asphyxia, starvation, diarrhœa; or by a complication, especially by pneumonia.

Pathology.—The changes in the glands in lymphadenoma resemble, in the early stage, those which result from simple irritation; and, as has been seen, the first enlargement often appears to be excited by local irritation. Clinically, however, the disease has a semi-malignant aspect. Dr. Wilks therefore assigned to it a position between cancer and tubercle. Its history suggests that it is due to both constitutional and local causes, and that the extent of these two elements varies in different cases. The constitutional predisposition apparently affects chiefly the lymphatic structures. The assumption of such a predisposition is necessary to explain the general affection of the glands which characterises some cases in the beginning, and also the persistence of the affection when it begins locally, as well as its subsequent extension. In the latter case, however, a process of secondary infection may be at work, the lymphatic tissues, already predisposed, becoming affected by the circulation in the blood of a *materies morbi* derived from the structures first diseased. Some cases present characters intermediate between lymphadenoma and scrofula—the low tissue-vitality of the latter leading to wide fatty degeneration and caseation of the new growth, instead of its fibroid transformation. The existence of an excess of white corpuscles in the blood does not present valid ground for separating certain cases from the rest, and calling them 'lymphatic leucocythæmia.' Most of such cases are, as has been said, forms of mixed disease. In simple lymphadenosis the Malpighian follicles of the spleen are diseased, and when there is a considerable excess of leucocytes in the blood, the splenic pulp is usually also increased in quantity. The anatomical lesions of splenic leucocythæmia and lymphadenosis are conjoined, and to the increase in the pulp the leucocytal excess is due. Occasionally, however, when the diseased glands are soft, lymphoid corpuscles, changed in character, pass from them into the blood, and persist there, leading to an excess of the pale cells. When the glands are hard, the production of lymphoid cells, and their passage into the blood, seem interfered with, and thus simple anæmia results.

Diagnosis.—Local glandular growths cannot be sharply separated from cases of generalised lymphadenoma, although they may be clinically distinguished. Generalisation may ultimately occur, even though one group of glands has alone been diseased for many years. In splenic leucocythæmia the glands are only affected late in the disease, after considerable enlargement of the spleen has existed alone for a long time. When the spleen presents great enlargement, and the glands are affected early, the case is usually of the mixed form above described, both splenic pulp and follicles being diseased. In scrofulous enlargement of the glands, the disease is commonly confined to a single group of glands which have been subjected to local irritation; some of the glands often soften and suppurate; the affection occurs chiefly in early life; and the other constitutional signs of scrofula are present. Cancer of the glands differs widely in its microscopical characters from lymphadenoma, but clinically the distinction from a local lymphoma may be difficult, and turns chiefly on the slow extension of cancer to neighbouring glands, and in its subsequent localisation in organs rather than in lymphatic structures.

Prognosis.—When the disease is widely spread, or the local growths considerable in size, a fatal termination is almost certain. The duration, however, in each case, varies much. The younger the patient, the better the preceding health, the longer is the duration of the disease. The consistence of the glands has little prognostic value. The softer they are, the more rapid is the course of the disease; but, on the other hand, if it is influenced by remedial agents, the soft glands can be restored to a better functional condition than the hard. The prognosis is worse the more profound the anæmia. Elevation of temperature as a rule indicates a rapid course, but to this there are some striking exceptions, as in one case under the writer's care, in which the glandular enlargement continued slight, although the temperature for twelve months was always above the normal.

Treatment.—The possibly infecting influence of the primary glandular enlargements has led to their extirpation. Where other glands, or the spleen, has been enlarged, the operation has done no good; and, in such cases, surgical interference is only justified by impending death from the local pressure. But where the affection has been confined to one group of glands, the progress of the disease has been retarded by their removal, and in some cases, the malady has even been cured. The degree of anæmia is of great importance as influencing the prospect of benefit, and even of survival from the operation, and the actual proportion of corpuscles should, in all cases, be estimated by the hæmacy-

tometer. An operation should never be performed if the proportion of red corpuscles is less than 60 per cent. of the normal. A slight excess of white corpuscles does not militate against the success of an operation. Other methods of local treatment have been employed, with some benefit, especially rubbing and shampooing, the alternate application of heat and cold, compression, and blistering. Galvanopuncture is useless. Various substances have been injected into the glands—iodine, nitrate of silver, carbolic acid, arsenic. The last has alone appeared useful (Winiwarter), but it was, in all cases, given internally at the same time. Of internal remedies arsenic is incomparably the most potent. It should be pushed to the largest doses the patient can bear, as ɱxv. of liquor arsenicalis three times daily. It often causes some pain in the glands, followed by their diminution in size, and even, in a few recorded cases, by their complete disappearance. Although such a favourable result has not come under the writer's personal observation, he has seen a marked diminution obtained in the size of glands which were before steadily enlarging, a diminution which has been maintained for years. Phosphorus has been given in the disease (first by Verneuil), but it is far less useful than arsenic. Iodine and iodide of potassium are of little service. Cod-liver oil is useful when there is any indication of a scrofulous diathesis. Mercury and carbolic acid have been given internally without success. Iron, useless alone, has sometimes appeared to do good when given in conjunction with other remedies. Change of air, general tonics, and careful diet are often of considerable service, especially when employed along with other measures. W. R. Gowers.

LYMPHANGEITIS (*νύμφη*, water, or lymph, and *ἀγγεῖον*, a vessel).—Inflammation of lymphatic vessels. *See* Lymphatic System, Diseases of.

LYMPHANGIECTASIS (*lympha*, lymph, and *angiectasis*, vascular dilatation).—Lymphatic varix, or varicose dilatation of lymphatic vessels. *See* Lymphatic System, Diseases of.

LYMPHATIC SYSTEM, Diseases of.—Synon.: Fr. *Maladies du Système Lymphatique*; Ger. *Krankheiten des Lymphsystems.*

There is no essential difference between the lymphatic and lacteal systems, which together constitute the absorbent system. In this article attention will be briefly directed to those diseases of the lymphatic vessels and glands which are more or less of a local nature; and what is stated with regard to the former will apply generally to the lacteals, but attention will be directed to any points connected with these vessels calling for special notice. Some of the affections involving these structures are considered in separate articles, and need, therefore, merely be mentioned here; while the mesenteric glands are discussed independently (*see* Mesenteric Glands, Diseases of). It may be remarked that recent pathological investigations point to the existence of important relations between the absorbent system and certain diseases, namely, some of those belonging to the zymotic class, and those depending upon septic conditions, such as plague, typhus and typhoid fever, diphtheria, erysipelas, glanders, malignant pustule, snake-bite, dissection or post-mortem wounds, and certain forms of serous inflammation, such as puerperal peritonitis. Moreover, the lymphatic vessels seem to be materially affected in some skin-diseases, such as erythema and elephantiasis; while there are structures which consist mainly of lymphatic follicles, and their diseases principally affect these follicles. The absorbent system is also concerned in an important degree in conveying morbid products from one part of the body to another, such as cancerous elements, tubercle, or the syphilitic poison, and thus of disseminating these diseases through the system. These points are more fully dwelt upon in their appropriate articles, and now the individual diseases of the lymphatic system will be discussed in their appropriate order.

1. **Acute Inflammation.**—According to the structures involved, acute inflammation, connected with the lymphatic system, presents three varieties, namely:—(*a*) where the vessels are alone affected—*lymphangeitis* or *angeioleucitis*; (*b*) where the condition is limited to the glands—*adenitis*; or (*c*) where both vessels and glands are involved. It will be convenient to consider these varieties together. As a rule the disease is localized, but under certain circumstances the lymphatic system is more or less widely implicated, especially if the inflammation is of a septic character. It may be set up and extend with great rapidity.

Ætiology and Pathology.—The causes of acute inflammation of the lymphatic vessels or glands may be thus indicated:—1. *Traumatic*, including such injuries as wounds, contusions, or a severe strain. 2. *Irritation from without.* Strong heat, as that of the sun, may set up inflammation of the superficial lymphatics. Pressure or friction may also produce this effect upon the vessels or glands. It is not an uncommon practice to excite inflammation artificially in the glands, for the cure of certain of their diseases, by injecting irritants into their substance. 3. *Irritation from within.* This may be due to inflammation in the vicinity, suppuration, ulceration, diseases of joints or bones, and other causes. In medical practice the implication of the glands under the jaw, in cases of diphtheria and scarlatina, is a familiar illustration of this class of cases; or the inflammation of the glands behind the ear in cases of impetigo of the head. It may also be noticed here that the lymphatic vessels are more or less involved in phlegmasia dolens. 4. *Specific irritations.* These deserve separate recognition, and include syphilis, gonorrhœa, and various septic poisons, which frequently affect the lymphatic structures. Inflammation of the absorbent glands is also an important feature in plague, glanders, and other diseases.

With regard to the modes in which the inflammation is set up, this may happen in several ways. In the first place, the cause may act directly upon the lymphatic vessels or glands, as in the case of injury. Secondly, these structures may be involved by extension from neighbouring parts. Glands are frequently affected in this way; and lymphatic vessels may be

involved by continuous extension of irritation from inflamed organs, serous membranes, or other structures with which they are connected. Thirdly, the cause of the inflammation is often more or less remote from the situation in which it appears, especially in the case of the glands. This may arise from the condition passing continuously along the vessels from some seat of irritation to the glands in their course; or morbid products may be carried by the current of lymph to the glands, the vessels themselves being unaffected, when the inflammation thus set up is said to be *sympathetic*. In other instances pus has been found within the lymphatic vessels, having made its way from some seat of inflammation. It may also be mentioned that lymphatic inflammation may originate a similar condition in other structures, such as the joints, and this may be of a purulent character.

Inflammation is much more readily excited in the lymphatic structures in some persons than in others, and especially in those who are of a strumous habit. The glands are more liable to be affected in the early periods of life. A low state of the general health may predispose to inflammation of these structures from slight causes. Glands which are chronically enlarged, as the result of inflammation, are very liable to become the seat of acute inflammation from slight causes.

Anatomical Characters.—Inflammation affecting the lymphatic vessels presents two forms, but they may be met with together. When the minute capillary network is involved, the condition is termed *reticular lymphangeitis*; the skin and its capillaries are generally affected at the same time, so that there is more or less diffused redness, but it may present a reticulated arrangement. *Tubular lymphangeitis* signifies that the main vessels are implicated. They are visible on the surface as red lines, straight or wavy, passing to the glands. They become dilated, and their walls thickened. Their internal coat is opaque and uneven, and the endothelium often disappears. Coagulation of the lymph within the vessels takes place, closing up their channel. The coagulum may become organised, so that they are permanently obliterated; or it may soften and even suppurate at the centre, and the products may enter into the general circulation, and thus cause septicæmia or pyæmia. The inflammation is liable to extend to the surrounding cellular tissue, leading to exudation, hyperplasia of cells, and consequent swelling and thickening.

Inflammation of lymphatic glands is characterised in the early stage by swelling, congestion, and increased firmness. The lymph accumulates, exudation takes place, and abundant cells are present. The inflammatory process may soon subside, terminating in resolution. In many cases, however, suppuration ensues, especially in certain forms of inflammation, this commencing in the centre of the glands, the cavities of which become more or less speedily filled with pus. The inflammation spreads to the surrounding cellular tissue, and, an abscess being formed, the pus makes its way to the surface. If the glands are internal, they may burst there, and lead to serious consequences; or by merely setting up irritation in adjacent structures, they may produce similar results. Sometimes the glands remain permanently enlarged and indurated, especially after repeated attacks of inflammation; and they may become adherent to the parts around. A single gland may be inflamed, but it is common for a cluster or a chain of glands to be involved. In some cases the inflammation assumes a more or less sub-acute character, and the progress of events is slower.

Symptoms.—These are *local* and *general*. The *local* phenomena consist of subjective sensations, and objective signs. Pain is felt at the seat of inflammation, which may be very severe, often accompanied with a sense of heat or burning, and stiffness or tension. There is usually marked tenderness, and this may be present when little or no spontaneous pain is complained of, while it is often remarkably limited to the line of an affected lymphatic vessel. Movement also increases the pain. The subjective sensations are more severe as a rule when the glands are involved. When suppuration takes place, the pain tends to assume a shooting and throbbing character. As regards objective signs, inflamed lymphatic vessels, if superficial, are usually visible as red lines, either straight or wavy, running in the direction of the glands; or there may be separate red patches. Should they be deeply situated, however, the vessels cannot be seen. The larger trunks may be felt by the fingers, being cord-like, firm, and knotted. The surrounding tissues are seen and felt to be more or less swollen and indurated. If the circulation of the lymph is much interfered with, a limb may be considerably enlarged, and presents a feeling of firmness and solidity, owing to the occurrence of lymphatic œdema.

When the lymphatic glands become inflamed, their enlargement can be detected, and the surrounding tissues may also be swollen. At first they feel firm, but if suppuration takes place they become more and more soft, and at last present a sensation of fluctuation. The overlying skin is markedly red, and there is often subcutaneous œdema. Suppurative inflammation of lymphatic glands constitutes the condition known as 'bubo.' If not opened artificially, the abscess ultimately bursts externally, but it may burrow considerably before doing so, and the opening is often imperfect. *See* Bubo.

The *general* symptoms accompanying inflammation of the lymphatic structures vary in their intensity in different cases, according to its severity, extent, and results. In the slighter cases there is no obvious constitutional disturbance. As a rule, however, more or less fever, with its accompanying symptoms, sets in, preceded often by shivering or even distinct rigors. If suppuration occurs the rigors may be repeated; the pyrexia increases; and more or less wasting follows, if there should be prolonged discharge of pus. Where the inflammation is of a septic character from the first, or when septic matters are conveyed into the circulation, the general symptoms are exceedingly grave, being similar to those indicative of septicæmia from other causes, such as repeated rigors, high and erratic fever, great weakness and prostration, low nervous symptoms, weak and rapid cardiac action and

pulse, and other typhoid phenomena. The termination is then usually fatal.

Treatment.—In the management of any acute inflammation affecting the lymphatic vessels or glands, the first indication is to get rid of its cause, if this be practicable. In the next place rest is of essential importance, and the affected part should be so placed as to avoid all pressure or tension. As regards *local* treatment, the application of heat and moisture, by means of fomentations and poultices, usually answers best. To these anodynes may be added, if necessary, especially belladonna; and the latter may be often applied with advantage in the form of extract, mixed with glycerine. It is not uncommonly advisable to take away blood locally from the neighbourhood of inflamed glands, by means of leeches. Some authorities maintain that suppuration may sometimes be prevented by counter-irritation around the glands, effected by applying blistering-fluid or strong iodine. If suppuration take place, the progress of the pus towards the surface must be encouraged by the usual means, and the abscess opened at the appropriate time. Should *general* treatment be required, at first it is usually necessary to keep the patient on low diet, to open the bowels well, and perhaps to administer some simple saline mixture. When suppuration occurs, a more or less supporting tonic and stimulant treatment is called for. In septic cases the free use of alcoholic stimulants, with the administration of full doses of quinine or salicine, constitutes the appropriate treatment.

2. **Chronic Inflammation.**—It is only the lymphatic glands which can be said to be liable to this affection—*chronic adenitis*. They may remain in a condition of chronic inflammation after one or more acute or sub-acute attacks; or this is set up as a chronic affection from some continued or repeated irritation. Formerly a low form of chronic inflammation was regarded as the primary lesion in scrofulous or tubercular glands, and some pathologists still hold this view. The affected glands are enlarged and firm, and usually somewhat painful and tender. These changes may be due partly to a hyperplasia of the gland-structures, partly to an exudation into their midst. Frequently they continue in this condition for a long time, without undergoing any obvious change, but they are liable to acute exacerbations from slight causes. They may ultimately become the seat of caseous degeneration, or of suppuration, even though there is no evident scrofulous diathesis. The circulation of the lymph through the involved glands is prevented to a greater or less degree. Usually there is no constitutional disturbance, unless a considerable number of glands are implicated, or they degenerate or suppurate.

Treatment.—It is not desirable to allow chronic adenitis to continue, as unpleasant or even serious consequences may ensue, and therefore it should be subjected to proper treatment without delay. Any source of irritation must be removed at the outset. Gentle friction over the enlarged glands, with some simple oleaginous or greasy material, may be effectual in reducing them, or it may be necessary to rub in weak iodine ointment, or to paint the surface with tincture of iodine. Counter-irritation by blisters may be sometimes useful. Internally cod-liver oil and quinine are frequently of much value; preparations of iron are also often very serviceable, especially the syrup of the iodide.

3. **Scrofulous or Tubercular Disease.**—The morbid condition of the lymphatic glands thus named may be conveniently discussed here, as the ultimate effects produced are very similar to those which result from chronic inflammation in certain cases. This affection, however, is supposed to be one of the manifestations of a particular diathesis—the *scrofulous* or *tubercular*—in which the absorbent glands are very prone to become the seat of certain changes of a destructive character. It will be discussed at greater length in other articles, and here it will suffice to offer a few general remarks on the subject.

Ætiology.—Scrofulous disease of the glands often occurs in those who present obvious characteristics of the diathesis; but this is by no means always the case, for the subjects of the glandular affection may be apparently strong and healthy. Children and young persons are by far most frequently affected. The glandular change may originally be set up by some irritation, which seems to give it a start, but in many instances there is no such obvious cause, and it appears to commence spontaneously. Once an absorbent gland becomes the seat of scrofulous changes, others in connection with it, or even at a distance, are very liable to become secondarily implicated.

Anatomical Characters.—Scrofulous disease may involve the lacteal as well as the lymphatic glands, and of the latter those within the body may be affected, as well as those which are external. This disease of the lacteal glands is separately discussed (*see* Mesenteric Glands, Diseases of); and also that of certain lymphatic glands within the chest (*see* Bronchial Glands, Diseases of). Of the external glands, those in the neck and under the jaw are most commonly involved. The changes always go through a more or less chronic course. At first the glands become enlarged and firm, and, according to most observers, this seems to be merely due to a hyperplasia of the lymphatic elements. These, however, possess but a very low degree of vitality, and have a marked tendency to degenerate and disintegrate, so that the tissues become destroyed. Ordinarily caseation takes place, the substance of the glands becoming yellow and softened; then a slow process of unhealthy suppuration generally ensues, leading to the formation of chronic abscesses. The skin over them presents a congested appearance, and is often undermined for some distance, the subcutaneous tissues being involved in the suppurative process. If the abscesses are not properly opened, they are liable to cause much destruction of the skin, and to leave unhealthy sinuses and ulcers when they burst of their own accord. If they subsequently heal, this is often attended by extensive scarring, and the scars are permanent, but become less marked in course of time. In some cases the glands do not suppurate, but after caseation they become calcified and inert; it appears that this result may take place even after the formation of pus, which then becomes inspissated, and mixed up with calcareous matter.

Symptoms.—In the case of the external glands, with which we are now concerned, the changes above described can be observed clinically. They are attended with little or no pain, but there is usually more or less tenderness. Constitutional symptoms are usually prominent, when the glands become to any extent the seat of scrofulous disease. There may be the symptoms of the diathesis; but the glandular affection itself also tends to produce wasting, anæmia, general weakness, and more or less pyrexia, which, if there should be abundant suppuration, is apt to assume a hectic type. If the glandular disease is limited, however, the system may suffer but little or not at all; and even after it has been extensive and severe, so as to lower the patient very much, recovery may take place under appropriate treatment, the patient ultimately becoming strong and robust. When the internal glands are affected, they may give rise to symptoms from their mere mechanical presence, such as those indicative of pressure or irritation; and if destructive changes occur in them, very serious results are liable to be produced. The general symptoms are also usually more marked in these cases, and may become extreme in degree. It must be remarked that it is highly probable that phthisis may be set up by an infective process, in connection with suppurating or caseous scrofulous glands.

Treatment.—*General* treatment is of essential consequence in the treatment of scrofulous disease of glands. The patient should be placed under the most satisfactory sanitary conditions that can be obtained; but in many cases this is a very difficult matter, and it is of great importance, if possible, to remove from their unhealthy and often wretched homes those suffering from this affection, and to treat them in suitable sanatoriums or hospitals. They should be as much as possible in the open air, and a change of air will often prove of decided benefit to those suffering from scrofulous glands. Residence at the seaside, with sea-bathing, is also of much service, or a sea voyage may be desirable. The digestive functions require careful attention and regulation; and the food must be nutritious, including abundance of good milk, fresh eggs, and such articles of diet. As regards medicines, those which are usually indicated are cod-liver oil, quinine, and preparations of iron, especially the syrup of the iodide, steel-wine, or Parrish's syrup. Where there is much suppuration, marked benefit has been found to result from the administration of minute doses of sulphide of calcium, and from chloride of calcium.

Local treatment is usually called for. In the early stages attempts may be made to cause absorption of the enlarged glands, but these must be cautiously conducted. Gentle friction, the application of preparations containing iodine or certain iodides, and the use of poultices or fomentation of sea-weeds, are the measures usually adopted. In some cases it certainly seems the best plan of treatment to try to encourage suppuration in glands which are in a torpid state, and which cannot be absorbed. For this purpose they have been injected with irritants. Suppuration and its consequences must be treated on ordinary principles; but it should be remarked that abscesses should not be allowed to burst of their own accord, but need surgical interference, as otherwise they may lead to much destruction of the skin and subcutaneous tissues.

4. Hypertrophy and Atrophy of Glands. The lymphatic glands become *hypertrophied* under different circumstances. In some cases there is a mere local hypertrophy, which shows no tendency to progress towards other parts, and which may be due to some obvious irritation, or independent of any known cause. As has been already pointed out, hypertrophy is the early condition of scrofulous glands. This morbid change is most important, however, in connection with the disease termed *lymphadenoma*, or *Hodgkin's disease*, in which there is a progressive enlargement of the lymphatic glands; and with one form of *leucocythæmia*. These affections are discussed in separate articles. Without entering upon any lengthy description, therefore, it will suffice to remark that in these affections the enlargement varies much in degree and extent in different cases; that it is due simply to an increase of the normal lymphatic structures; and that the glands usually show no tendency towards any degenerative or destructive change. Clinically they are recognised by their obvious physical characters when superficial; or by physical signs when situated in internal cavities. As a rule they are painless; but may give rise to various symptoms by their mechanical pressure, irritation, or destructive effects. In many cases more or less severe general symptoms are present. *See* Leucocythæmia; and Lymphadenoma.

Atrophy of lymphatic glands may occur after inflammation; as a senile change; after the removal of a limb, or its long-continued want of use; or from other causes. No definite effects can be referred to this condition, but if there should be extensive glandular atrophy it might obviously interfere with the due nutrition of the blood and general system.

5. Morbid Formations and Deposits in Glands.—Under this heading the following may be considered:—

a. Cancer.—The various forms of malignant growth frequently involve lymphatic glands. In most cases the disease is secondary to cancer in some neighbouring part, and the glands are very prone to become involved, owing to the cancer-elements being directly conveyed to them by the lymphatics. This is well exemplified by the implication of the axillary glands when the breast is the seat of cancer. Not uncommonly, however, the formation is primary in the glands, and then involves other structures by direct extension or convection. All forms of malignant disease are met with, but the encephaloid variety is most common. When secondary, however, it generally approximates in characters to the primary formation, and hence may be of a scirrhous or melanotic nature. It may also be mentioned here that secondary sarcoma occurs in the lymphatic glands. The growth may attain a considerable size, and it is more or less nodulated. The consistence will depend on the variety of the cancer; often it is soft, and a milky juice escapes on pressure. If cancerous glands are external, they can be recognised on examination, and are usually painful and tender.

When situated internally they give rise to physical signs of their presence, either in the chest or the abdomen; and to more or less pressure-symptoms; which may be combined with the constitutional symptoms of malignant disease. It may be very difficult to distinguish clinically between cancerous glands and lymphadenomatous growths situated internally.

b. Albuminoid disease.—The glands are liable to be involved in conditions which give rise to albuminoid degeneration. On section they present the peculiar waxy, pale, translucent, homogeneous appearance characteristic of tissues which are the seat of this change. The glands may be enlarged; but when they attain a considerable size, this is partly due to hypertrophy. In other cases they are small and firm. This condition may give rise to symptoms by pressure, as sometimes happens in the case of albuminoid glands in the portal fissure, which may cause ascites or jaundice.

c. Pigmentation.—The bronchial glands may be the seat of a deposit of black particles in cases where the lungs are thus affected, as in miners, colliers, &c. They are enlarged to some extent, and black; and a black liquid escapes on pressure. This condition does not give rise to any obvious symptoms. More or less pigmentation of these glands is often observed with advancing age.

d. Syphilitic growths.—The glands in the groin are affected from the irritation of the primary syphilitic sore, and others are often involved in connection with its secondary and tertiary effects; but no doubt they are also liable to become the seat of special syphilitic formations.

e. Tubercle.—The condition of glands usually termed 'tuberculous' has been already considered, but sometimes distinct grey granulations are found in connection with acute tuberculosis. They originate in the follicles of the glands.

Treatment.—Practically the treatment of the morbid formations in glands just considered, if any be called for, consists in measures directed against the constitutional condition of which they are a manifestation. In the case of cancer, operative interference may be demanded. Symptoms, especially those resulting from pressure, may also require special treatment.

6. Chronic Changes affecting Lymphatics.—The lymphatic vessels are subject to two principal classes of chronic changes, namely (*a*) *Dilatation* and *hypertrophy*: and (*b*) *Obstruction.*

a. Dilatation and hypertrophy—Lymphangiectasis.—Leaving out of consideration the thoracic duct and receptaculum chyli, the lymphatics, either superficial or deep, and also the lacteals, may become more or less dilated and hypertrophied. Even the vessels of internal mucous or serous membranes may be thus affected. In most cases the larger trunks are implicated, but the capillary plexuses are sometimes chiefly or alone involved. With regard to the causes of this condition, it is often congenital, and has then been attributed to a want of specialisation in the lymphatic system of certain parts. In other cases it is evidently due to some obstruction to the circulation of the lymph, and consequent enlargement of the vessels behind the impediment. Such obstruction may be seated in the glands or vessels, and in the latter case may be due to internal plugging or to external pressure. In some instances the enlargement of the lymphatics partakes of the character of a primary hypertrophy, either alone, or along with other tissues, as in connection with elephantiasis and other growths, of which enlarged lymphatics constitute an important element. Dilatation has been also attributed to a supposed paralysis of the muscular coat of the lymphatic vessels. Lymphangiectasis is most common in warm and moist climates.

There are various forms which enlarged lymphatics assume. Thus, there may be simply a localised dilatation of the capillaries, constituting a visible freely-anastomosing reticulum or network. More commonly the trunks are enlarged, assuming a tubular, fusiform, varicose, saccular, or cirsoid form. Or a distinct growth may be produced, which has been specially termed *lymphangiectasis*, and has been divided by Wagner into three varieties—(i.) *simple*; (ii.) *cavernous*; (iii.) *cystoid*—names which sufficiently indicate their several peculiarities. The walls of the vessels are often more or less thickened from hypertrophy. Dilated lymphatics are liable ultimately to give way, with consequent escape of the lymph.

Clinically the conditions now under consideration are visible when superficial, or when occurring on a surface which can be inspected. The appearances will differ according to the particular morbid change present. There may be a distinct tumour; or the enlarged lymphatics may only form one element in certain growths. Cystic formations originating in the lymphatic system are said to be most common in connection with the upper lip, tongue, and neck. It is beyond the province of this article to describe these conditions in any detail. Enlargement of the superficial lymphatics is chiefly observed on the inner side of the thigh, the sides of the abdomen, and the scrotum and penis; they appear in the form of vesicles like grains of sago, grouped regularly or irregularly. Sometimes only ampullæ are formed, which are generally soft and painless. These conditions have been mistaken for hernia, abscess, scrofulous glands, and other diseases. Should the dilated lymphatics rupture subcutaneously, vesicles containing a clear or milky fluid appear. They may rupture on the surface of the skin, the lymph being discharged externally, which is an important element in the diagnosis of doubtful cases. When dilated absorbents are situated internally, they cannot be recognised unless they should happen to rupture, with the escape of their contents by some outlet. This applies mainly to the lacteals, the contents of which may pass out with the stools, and to the urinary mucous membrane, it being supposed by some pathologists that the condition termed *chyluria* is merely due to the rupture of dilated lymphatic vessels in this membrane.

b. Obstruction.—As in the case of dilatation, the capillary plexuses or larger lymphatics may be obstructed. This may arise chiefly from plugging of their channels by coagulated lymph; inflammation of the vessels; pressure by enlarged glands, aneurisms, or other tumours, or merely

as a result of inflammation of the cellular tissue around the vessels. It may be remarked here that lymphatic tissues, similar to those observed in the glands, sometimes form here and there in the course of the lymphatics in cases of lymphadenoma. The lymphatics of the urinary mucous membrane are also supposed by some pathologists to become the seat of aggregation of the animal parasites named *filariæ*, and they consider that this is the cause of chyluria.

The effects liable to be produced by obstruction of lymphatic vessels are swelling, from so-called lymphatic œdema; and dilatation of the vessels behind the obstruction, which may lead to their rupture. It is by these effects alone that this condition can be recognised clinically.

Treatment.—But little can be done for the chronic changes now under consideration affecting lymphatic vessels. Proper bandaging, or the use of some elastic support, may be of use in treating dilated vessels, if they happen to be conveniently situated. Friction and kneading may assist in removing lymphatic œdema due to obstruction. Growths come under the treatment of the surgeon, and do not call for any special remark here. Frederick T. Roberts.

LYMPHATIC TEMPERAMENT. *See* Temperament.

LYMPHOMA.—A synonym for lymphadenoma. *See* Lymphadenoma.

LYMPHORRHAGIA or LYMPHORRHŒA (*lympha*, lymph, from *νύμφη*, water; and *ῥήγνυμι*, I burst forth, or *ῥέω*, I flow).

Definition.—These terms literally signify a flow of lymph, but they are used to indicate an abnormal discharge from any part of the absorbent system, whether it be of lymph or of chyle.

Ætiology and Pathology.—Lymphorrhagia may take place from the lymphatic capillaries or trunks; from the lacteals; from the absorbent glands; or from the receptaculum chyli or thoracic duct. Cases in which this condition occurs are usually divided into *traumatic* and *idiopathic*, according to their apparent causation. In the former the cause is a wound, which generally affects either the thoracic duct, the larger lymphatic trunks, or the glands. A discharge of lymph has in rare instances followed even a slight wound, particularly in the neighbourhood of joints, and this was attributed by the late Mr. Messenger Bradley to a constitutional defect—a *lymphorrhagic diathesis*, corresponding to the hæmorrhagic diathesis. *Idiopathic* lymphorrhœa is almost always the result of dilatation of a vessel or vessels, which ultimately rupture. They are often greatly distended before they give way. Allusion may again be made here to the supposed relation of chyluria to the presence of *filariæ* in the lymphatic vessels of the urinary organs, these parasites causing them to rupture, and the lymph consequently being discharged with the urine.

Symptoms and Effects.—Should an escape of lymph take place upon any part of the surface of the body, it differs much in its quantity and characters in different cases. It may be less than an ounce, or amount to five and even ten pounds within the twenty-four hours; while in the same case its quantity is liable to variation from time to time, and the flow has even been known to assume a periodic character, increasing during the period of digestion. In traumatic cases the discharge either presents the ordinary appearance of lymph, being clear and limpid, or it is mixed more or less with blood or with inflammatory products. When rupture takes place spontaneously after dilatation of the vessels, the fluid is more like chyle, being more or less milky and white, from the presence of particles of fat, but its characters are liable to alter from time to time. It contains a variable quantity of fibrinogenous elements, and is proportionately disposed to coagulate spontaneously. Internal lymphorrhagia causes different results. In the case of the intestines and urinary organs, the fluid is discharged with the fæces and urine respectively, in the former case being supposed to give rise to fatty stools, and in the latter to chyluria. The late Mr. Bradley attributed some cases of effusion into serous cavities, such as certain forms of hydrocele, hydrocephalus, pleuritic effusion, and ascites, to a lymphorrhagia into the respective cavities; and the writer has met with a case of ascites which seemed to support this view. Fatal peritonitis has resulted from the entrance of chyle into the peritoneum, owing to the rupture of a dilated receptaculum chyli. The escape of lymph or chyle out of the system tends to affect the general health, and if it is in large amount, this is likely to lead to marked emaciation, debility, and anæmia.

Treatment.—In external lymphorrhagia all that can be done is to check the flow of lymph by pressure of bandages, and the application of astringents. In cases where it takes place into internal passages, tincture of iron in full doses may be of service. The general condition must be attended to, and improved by nutrients and tonics, if required.

Frederick T. Roberts.

LYPEMANIA (*λύπη*, grief, and *μανία*, madness).—The name applied by Esquirol to the form of insanity characterised by mental depression, usually called melancholia. *See* Melancholia.

LYSIS (*λύω*, I dissolve).—This word had formerly various significations, but is now generally applied to the *gradual* decline of any disease or pathological process, especially fever. *See* Fever.

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